CULTIVATED PLANTS

"The engrafted Apple, blending kindly growth,
Transforms the kindred Pear-tree, nothing loth;
Leaves barren habits in the native wood,
And joys to yield a fruitage apt for food;
Makes smooth the spiny Plums and prickly Thorns,
And with gay foliage novel boughs adorns."

—PALLADIUS: *De Insitione*, 78-82.

"The Mountain Ash in white Pear-flowers arrayed."

—VIRGIL: *Georg.* ii. 69.

CULTIVATED PLANTS

THEIR PROPAGATION AND IMPROVEMENT

F. W BURBIDGE

AUTHOR OF
'DOMESTIC FLORICULTURE,' 'THE NARCISSUS: ITS HISTORY AND CULTURE,' EDITOR OF THE 'FLORAL MAGAZINE,' ETC

> I would I had some flowers o' the spring that might
> become your time of day .
> pale Primroses
> That die unmarried ere they can behold
> Bright Phœbus in his strength
> —*Winter's Tale*

WILLIAM BLACKWOOD AND SONS
EDINBURGH AND LONDON
MDCCCLXXVII

TO

J. D. HOOKER, C.B., D.C.L., LL.D.

PRES. R.S., AND DIRECTOR OF THE ROYAL BOTANICAL GARDENS AT KEW

This Work is Dedicated

IN RECOGNITION OF THE KINDLY ENCOURAGEMENT

FREELY EXTENDED TO THE

HUMBLEST STUDENT OF NATURAL HISTORY,

AND AS A TOKEN OF

APPRECIATION OF HIS DEEP INTEREST

IN THE WELFARE OF

BY FAR THE MOST COMPLETE EXISTING

COLLECTION OF CULTIVATED PLANTS,

BY THE AUTHOR

PREFACE.

THE late Dr Lindley, when preparing the preface for his father's 'Guide to the Orchard,' wrote the following: "There are two great considerations to which it is above all things necessary that the attention of the cultivator should be directed—namely, AMELIORATION and PROPAGATION." And with this object in view the present handbook has been prepared. Plant-propagation is one of the most important branches of cultivation as practised in our gardens; and especially is this so in the case of hybridism and cross-breeding, on the scientific aspects of which so much has been written to the purpose in our time. In this work the practical side of the question has been chosen, since there here seemed a comparatively open field for a work of this kind, which, apart from its primary use as a popular handbook on plant propagation and improvement, might also serve young gardeners as a stepping-stone to works of a higher scientific character, and more especially to those of Charles Darwin.

F. W. B.

RAVEN'S VILLA, UPPER TOOTING, S.W.,
December 13, 1876.

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THE PROPAGATION AND IMPROVEMENT OF CULTIVATED PLANTS.

INTRODUCTION.

'To study culture, and with artful toil
To 'meliorate and tame the stubborn soil;
To give dissimilar yet fruitful lands
The grain, the herb, the plant that each demands,

. . . . . .

These, these are arts pursued without a crime,
That leave no stain upon the wings of Time."
—COWPER.

THE propagation and improvement of cultivated plants is one of the most attractive and satisfying of all human occupations. From the vegetable kingdom we derive, directly or indirectly, our food and clothing; and we have also the power to ameliorate or alter the supply, according to the tastes of the age in which we live. This power to alter and improve the earth's produce, if rightly used, becomes one of the most noble and beneficial of all arts; one of the most intelligent of all the practical ends of science or organised intelligence, and yet one of which the very threshold is as yet barely reached. The word food, as here used, has a wide meaning,—for beauty, and especially floral beauty, is food in one of the highest of all the senses in which the word may be understood; and although it may not have originally been actually essential to the mere existence of man as an animal, what a wealth of poetry and beautiful ideas, which go to make life so keenly enjoyable, should we have lost had not mankind from the earliest times reverenced flowers, perhaps from a feeling of gratitude, since

fruits and roots formed man's earliest food! The cultivation of the soil, and consequently the artificial improvement of plants, has been practised ever since the first man tilled the garden; and some of the artificial methods of propagating existing forms of vegetation already improved by culture have been employed from time immemorial. Herodotus describes the process of fecundation—that is, the transference of the pollen from the male to the female trees, by which the ancient Egyptians insured a crop of Dates. Virgil, Martial, Columella, Galladius, and Pliny all speak of grafting, although not always correctly; but many years elapsed ere Grew pointed out the sexual organs of hermaphrodite plants. Indeed, even now, man is but a bungling novice in his recently assumed office of marriage priest in the garden. The balmy zephyr, and curious insect on hidden sweets intent, have performed the noble office since creation for the flowering-plants of every clime, just as they still perform the plant or flower nuptials on every mountain-side and dewy meadow and trackless forest in the universe, for man is as yet but strong enough to perform priestly functions for his captives in the garden. I said that Zephyrus had assisted in fertilising flowers, and this is true of very many plants. Have we not noted the clouds of pollen or fertilising dust shaken by the breeze from the tapering Pine, the sombre Yew, or gloomy Cypress? Or if the garden is more familiar than the forest, the benefit of a current of air during sunny weather, and its pollen-wafting influence, on the setting of early Peaches or Golden Muscatelles, is well known. Again, while we banish our thrifty neighbour's honey and pollen collecting bees from the conservatory, where they cunningly cut the throats of every Achimenes flower in the most systematic manner, because they somehow know the nectar is there, but cannot creep down the slender tube to secure it; yet we welcome them among the flowers in the early Peach houses, just because we know that they fertilise a flower, and secure for us a delicious rosy-cheeked Peach or Nectarine for every drop of honey they steal, or rather, rightly earn. The breeze and the insect are, then, essential to the welfare of flowering-plants; but how about Ferns, Mosses, Mushrooms, and other so-called flowerless plants? Here are no dusty life-laden pollen-grains to be wafted by the breeze or carried by the insect, and so there are no hidden sweets and no bright colours.* But if these indirect agents are here useless, it is not because agents to secure fruition are not required. The same end has to be reached, but by differ-

* "Ah!" says an observing friend, "you should see the Fly Agaric" (*Agaricus muscari*)—"a glowing shield of scarlet enriched with pearls."

ent ways and means; and this time fair Daphne celebrates the "concealed union" before Apollo has risen in the early morning, or when he dozes at noontide behind cushioned rain-clouds. The male and female organs of Ferns and other flowerless plants (cryptogams) are produced after the germination of the spore; and to enable the male fecundating bodies (spermatozoids) to travel to the female organs (archegonia), a thin film of water between the two bodies is essential, and this is naturally supplied by mist or dew or rain. This is the reason that the terrible Potato fungus (*Peronospora infestans*) develops itself most rapidly during wet weather; indeed, like some other fungi, it cannot develop itself unless in a moisture-laden atmosphere.

Plants may be considered as the most noble of inanimate organisms, and as such it would be marvellous to note the precision with which the types or species propagate or reproduce themselves naturally, and in many cases unaided, had we not come to look on the whole labour as an everyday matter of course. We will, however, just glance at the principal methods, sexual and vegetative, by which plants are naturally reproduced.

SEEDS.

"To watch the matchless working of the Power
That shuts within its seed the future flower."
—COWPER.

A large proportion of all known plants reproduce themselves when in a state of nature from seeds which fall or are scattered on the earth's surface as soon as they are ripe, and occasionally are covered by the falling leaves, which not only afford some protection from frost, but ultimately afford nutriment to the young plant. This is a most interesting fact; and one phase of culture, the effects for good and evil of which are scarcely sufficiently appreciated by cultivators, consists in a direct violation of this rule or natural law, since nearly all the seeds of cultivated vegetables, hardy as well as tender, are kept out of the ground from seed-time or harvest in summer or autumn, until the succeeding spring. Again, the seeds of cultivated plants are rarely allowed to remain on the plants until they are perfectly ripe. Some wild plants, however, do not shed their seeds until the warm sun-heat of spring causes the capsules to burst; and some writers contend that the action of frost is beneficial to the seeds of all hardy plants rather than otherwise. Many plants of strong constitution and rapid growth produce large quantities of seed, and readily adapt themselves to any

soil or situation, and such plants are found in immense numbers over nearly the whole surface of the earth. The natural families of corn plants or grasses and composites serve as familiar examples. It is well known to cultivators that many plants dwindle, and never become properly developed, if too close together. Corn plants or cereals, indeed, acquire a distinct habit from being grown closely together generation after generation; and Dame Nature herself seems conscious of this fact, if we think of the many and varied contrivances by which the seeds of plants are dispersed or scattered, so as naturally to secure a change of soil. The seeds of most composite plants, or members of the Thistle and Dandelion family, are furnished with downy appendages (pappus), which are sufficiently buoyant to bear them up in the slightest breeze; hence they become "as rolling things before the wind." The Squirting Cucumber affords another curious illustration of how nature manages to sow her seeds on new ground, so as to secure a rotation of crops, and in this case the slimy seeds are thrown out of the fruit (by the sudden contraction of its tissues) to a distance of several yards; while our native Gorse or Whin, and the common Broom, afford instances somewhat similar. Where trees and other seed-bearing plants overhang rivers or streams, the seeds often fall in the water, and are carried for many miles by the current, until by some accident they are washed ashore, and germinate to produce seed themselves, which in its turn is carried still further by the tide. The seeds of tropical Orchids are as fine as sawdust, and very much lighter, the least breath of air being sufficient to waft them along, until they lodge on a dead or partially decayed tree or branch, which they not unfrequently wreathe with their foliage and flowers; while others vegetate on moss, grass, and other low vegetation. Birds often aid in distributing the seeds of fruit-bearing trees and shrubs. This is particularly the case with the Mistletoe; and the apparently wild Gooseberry and Currant bushes found in hedgerows, or on decayed trees and ruins, are not unfrequently propagated by birds, who have carried the fruit from neighbouring gardens.

Seeds are not unfrequently rubbed off low-growing vegetation, and carried long distances in the hairy covering of wild animals; and some plants follow the footsteps of civilisation everywhere. What seeds are to the flowering-plants, spores are to Ferns, Mushrooms, and other cryptogamic vegetation. It is true that the spore is not quite the same in structure as a seed, and the manner of its germination is very different, but for all practical purposes they may be considered the same. Many spores are so small—scarcely visible, indeed,

to the eye, even with a good lens—and are so extremely light, that the slightest breath of air serves to waft them from the parent plant, and they thus travel immense distances unseen; or they, like seeds, are carried in the plumage of birds or the coats of animals. There are myriads of these subtle reproductive bodies continually floating about in the atmosphere, ready to germinate whenever they fall in suitable situations.

OFFSETS.

Many plants reproduce themselves very readily by offsets, which may be considered as nature's method of doing what propagators speak of as division. Offsets are often produced in the form of little bulbs, bulbils, or tubers, as in the Potato-onion, Hyacinths, and many other bulbs, many terrestrial Orchids, and in the common Potato. *Lilium bulbiferum* bears little bulbils in the axils of its leaves; and in the genus Fourcroya, which is nearly related to the American Aloes or Agaves, a great number of bulbils are borne on the flower-stems, and evidently supply the place of seeds. Offsets do not always take the form of bulbs, however; for in many fruit-trees and ornamental shrubs, offset-shoots—or suckers, as they are technically called—are produced from the underground stems or from the roots, and much of the dense undergrowth in woods and forests is produced in this manner. Sometimes nature takes precautions to distribute her offsets just as she does her seeds, and we see evidence of this in the garden and wood Strawberry, where the offsets are technically termed "runners," in many grasses, in the "Sailor plant" (*Saxifraga sarmentosa*), in the Goethe plant (*Chlorophyton Sternbergiensis*), and many others. This natural kind of division, or the production of "offsets," "runners," "suckers," "stolons," or whatever they may be called, is a wise and auxiliary force which often succeeds in reproducing the plant under peculiar circumstances or conditions, where seeds or spores fail. Nor is this kind of power confined to flowering-plants alone; for Mushrooms and other fungi are reproduced by slender underground threads (mycelium), which not unfrequently travel immense distances before they find the peculiar conditions of nitrogenous food, moisture, heat, or shade necessary for the full development of the plant. Again, other cryptogamic plants, as Ferns, of which *Asplenium bulbiferum* or *Osmunda orientalis* may be cited as well-known examples, are viviparous, producing young plants on the surface of their fronds, so that when the old frond falls to the earth, these young individuals take root

and continue the species. The common Lycopodium or Club-moss produces offsets which extend the area occupied by the plant in every available direction; and the same is true of the tropical Selaginellas and many other flowerless or so-called flowerless vegetables.

Seeds and offsets may be considered as nature's main plan of reproduction; but some plants, the common Bramble for example, are not unfrequently propagated from layers; and the branches and stems of many other plants readily take root when trodden in the earth accidentally by the larger animals. In some cases plants are propagated from cuttings in a state of nature—accidentally perhaps, but still not unfrequently; as when swans and other vegetable-feeding water-birds break off portions of the plants on which they feed, which float away and root elsewhere; or when branches and twigs are broken off by high winds, and fall into moist earth and take root. We have even examples of natural grafting (inarching) in nature, as shown by climbing species of Ficus, or even very frequently in the common Linden-tree and Ivy, where two branches, or the trunk and a branch, become firmly united together. Natural grafting is, however, rarely if ever employed by nature as a reproductive force, but rather as a means of securing additional strength or power of climbing to a stronger support.

NATURAL HYBRIDISM.

Hybridising and cross-breeding, although generally regarded as artificial methods of propagation as used by man, are nevertheless very frequently employed by nature not merely to perpetuate, but also to strengthen and invigorate herself. Thus we see that in many plants especial provision is made to prevent self-fertilisation. This is especially so in the Primrose family, and also among Orchids, Yuccas, and Asclepiads, nearly all of which require insect or other mechanical aid to assist in their fertilisation. But while these plants cannot fertilise themselves, it is often very difficult indeed to prevent cross-breeding, or even hybridisation in others, of which the Cucumber and Melon or Cabbage families serve as excellent examples. In the case of the Melon, the male and female organs are borne in separate flowers; and early in the season, if one variety only be grown, artificial fertilisation is often necessary to enable the fruit to "set;" but if two or more kinds are grown, and all flower together, they set freely without any aid—and, as the gardener is well aware, it is next to impossible to keep any particular variety true, so apt are nearly all Cucur-

bits to vary from cross-fertilisation. Cabbages vary in the same way. Look at the numerous forms of the common wild Cabbage (*Brassica oleracea*) for example. Take the Broccoli, with its crowded and swollen head of partially developed flowers; the Brussels Sprout, with a score or more little Cabbages up the lengthened stem, and a big one at the top,—and compare them with the weedy wild Cabbage, and this will show something of the effects of cross-fertilisation, judicious selection, and good cultivation. There can be no doubt but that new varieties, new forms of vegetation, have been naturally produced ever since the winds first swept over plant-clad hills.

The difference between plants is most apparent in their modes of living and feeding and working, and if we wish to obtain any real botanical knowledge, we must study life and health, as well as death or disease. De Candolle, in one of his letters to Mrs Somerville, says: "I advise you above all to see the plants at all their ages, to follow their growth, to describe them in detail—in one word, to live with them more than with books."

I have only sketched out some of nature's more apparent modes of reproducing herself, in order to induce the reader, if possible, to observe for himself. Some of nature's processes are, however, so subtle, so complicated, and so attractive, that a volume ten times the size of this might be written on that one subject alone. The gardener has immense opportunities in the garden, and may by careful study of nature add much to our knowledge. We have the descriptive and arranging or classifying botanist, and the physiological botanist, ever on the look-out for new facts; and if the cultural botanist is wise, he will not be outdone in assiduity, seeing that his occupation is of all the most useful and attractive. Among the most remarkable cases of natural hybrids—that is, hybrids in a wild state—are, according to Lindley, the following: "*Cistus ledon*, constantly produced between *C. monspessulanus* and *C laurifolius;* and *C. longifolius*, between *C. monspessulanus* and *C. populifolius*, found in the wood of Fontfroide near Narbonne, and mentioned by Bentham. The same acute botanist ascertained that *Saxifraga luteo purpurea* of Lapeyrouse, and *S. ambigua* of De Candolle, are only wild accidental hybrids between *S. aretioides* and *S. calyciflora:* they are only found where the two parents grow together, but there they form a suite of intermediate states between the two. Gentians having a similar origin have also been remarked upon the mountains of Europe."

Darwin (See Jour. Linn. Soc., vol. x. p. 451) mentions the common Oxlip (*P. acaulis* × *P. veris*) as being one of the most abundant and familiar of all natural hybrids, and alludes to

naturally produced hybrid Willows (*Salix*) as being equally numerous; and he also cites the Narbonne Cisti above alluded to, and many hybrids between an Aceras and Orchis (See Dr Weddell's observations in Annales de Sc. Nat., 3d series (Bot.), vol. xviii. p. 6). Verbascum is given as another example, and numerous interesting details may be seen in the Linnæan Society's Journal cited above. Among Phalænopsids and Odontoglots we have several plants so strikingly intermediate between apparently distinct species, that we are quite as fully justified in assuming that they are natural hybrids as we should be in naming and describing them as new species.

Orchis purpureo-militaris, *O. morio-papilionacea* are wild Continental hybrids, and one has been produced between *O. galeata* and *Aceras antropophora.* M. Timball-Lagrave has described other new hybrid forms of Orchis, and a remarkable intermediate or mule between a species of Serapias and *Orchis laxiflora.* M. Koch, in the second edition of his "Synopsis," alludes to and describes 36 hybrids in the genus Circium alone; to say nothing of the hybrid Primulas, Narcissus, Roses, Brambles, Violets, Hieraciums, and those of other genera which are known to exist, and to many of which we shall hereafter allude.

HINTS ON THE IMPROVEMENT OF OUR FRUITS, VEGETABLES, AND FLOWERS.

"But various are the ways to change the state
Of plants, to bud, to graft, t' inoculate"
—DRYDEN'S *Virgil*, Georg II

THE one great question to all intelligent horticulturists, whether professional gardeners or amateurs, is, How are we to improve? and this innate desire to go a step farther than our predecessors, the spirit of emulation excited and fostered by horticultural societies or their exhibitions, and the skill, energy, and enterprise of our nurserymen, have already made this noble labour of improvement a popular, and, what is more, a profitable one, and we need not look far for examples of the marvellous changes wrought among garden-plants even in our own time. The Orchids and Nepenthes of Dominy, the Clematis of Anderson-Henry, Jackmann, and Cripps; the hardy Rhododendrons of Standish, Noble, and Waterer; the greenhouse hybrids of Messrs Veitch; the Ericas of Rollison and Jackson; the Azaleas of Smith; the show Pelargoniums of Hoyle, Foster, and Turner; the Scarlet and Zonal races of Beaton, Paul, Denny, Pearson, and Hibberd; the double-flowered Zonals and Scarlets of Laxton, Sisley, or Lemoine; the Golden Tricolors of Grieve; and the Bronze Zonals of Wills,—are all the result of hybridism and careful cross-breeding, to say nothing of the innumerable selected races of Cyclamens, Pansies, Hollyhocks, Dahlias, Roses, Gladioli, Hyacinths, Tulips, Narcissus, Pentstemons, Phloxes, and other popular florists' flowers which now grace our gardens. If there is one branch more neglected than another in this march of improvement it is our hardy fruits, and more especially Apples, Pears, and Cherries; indeed, since the death of Mr T. A. Knight, there have been scarcely any systematic attempts in this country to improve any of our fruit-trees, notwithstanding the facilities afforded by our modern system of growing small bush-trees in

pots in the orchard-house, these small trees being sheltered from inclement weather, and entirely under the control of the hybridiser. We must, however, not fail to point out the great improvements effected by Mr Thomas Rivers, who has added many valuable varieties of Peaches, Nectarines, and Plums to our collections; and these varieties may be referred to as examples of what may be effected among other fruits by careful cross-fertilisation and judicious selection. A few years ago our hothouse Grapes consisted mainly of Black Hamburg and Muscat of Alexandria, together with Muscadines and one or two other varieties of less note; but here again we have examples of the power possessed by the intelligent cultivator, perhaps the most valuable of the new kinds being the late-keeping Lady Downes's Seedling, Madresfield Court, Mrs Pince's Black Muscat, Duke of Buccleuch, Golden Queen, and Dr Hogg. Nor have vegetables been left behind: indeed, one of the most striking examples of the valuable results to be obtained by careful systematic cross-breeding and selection is the race of new Peas raised by Mr Thomas Laxton, some of these varieties having the combined good qualities of dwarfness, extreme precocity, and the most delicious marrow-like flavour. Every year, too, brings us fresh, and in some few cases actually better, selections from such types as those afforded by the Cabbage family, Cucumbers, Melons, Onions, Peas, Beans, and other vegetables; and the same is true of some farm-crops, and notably of Turnips and Mangels. Cereal crops deserve more attention than they have hitherto received; and careful selection and judicious change of soil every two or three years would do much to improve these and other farm-crops.

Let us, however, now glance at the means of improvement possessed by the gardener. One of the most universal and potent of these is cultivation and change of seed, which means a change of soil. Careful selection of seminal forms or sports often affords a basis for future improvement; and hybridism, cross-breeding, and grafting are other valuable aids which have already enabled the intelligent cultivator to accomplish much, and will yet aid him to do much more. Cultivation alone works great changes in many wild plants—indeed it has been adopted from the earliest times as a means of changing wild plants, and rendering them more useful either for food, clothing, or medicine. By cultivation we favour the development of characteristics we know will be useful to us, by repressing those characteristics which we do not require. Thus we favour the production of leaves in compact heads in the Cabbage and Lettuce, but we favour leaves on the Grape Vine only so far as may be necessary towards the pro-

duction of fine fruit, all others being removed. Thus in some plants the cultivator favours leafy or vegetative growth, while in others sexual vigour is also requisite, and this is especially the case in all our fruit-bearing trees; and here the aim of the hybridiser is to produce fertile varieties—that is, varieties in which sexual vigour and vegetative growth are pretty equally balanced. In some cases, however, where the vegetative growth is much in excess of sexual vigour, it is balanced by root-pruning or by summer pinching, or by grafting on stocks which restrict the vegetative growth, as when we work strong-growing Pears on the Quince, or Apples on the Paradise stock. In cases where sexual vigour is in excess of the vegetative growth, as when trees are half starved on poor soils, we adopt different measures, such as grafting on more vigorous-rooted varieties as stock, or the application of manurial stimulants. The whole question of culture is based on the fact that each plant consists of diverse characteristics, some of which are antagonistic to others; and by repressing those characteristics we do not want, we give the others which we do require a better chance of full development. Thus it will be seen that by grafting and pruning we are able to adjust the balance between vegetative growth and sexual vigour, and so make a tree more fruitful than when on its own roots; but then both pruning and grafting are unnatural, and only tolerated because we have not yet fully learnt the art of raising varieties suited to different soils in which sexual and vegetative growth are naturally balanced: and this leads us to a very important point, and illustrates how, by a combination of grafting and seminal reproduction or hybridism, we may hope to work great improvements in many of our fruit-trees by raising new varieties in which the balance between fertility and vegetative growth is so equal that pruning will be reduced to a minimum and grafting superseded. All our experience points to the fact that seedlings from a tree in which vegetative growth is predominant will never be so fruitful as those from a tree in which sexual vigour, whether naturally or artificially produced, is in the ascendant; and it is a well-known fact that grafting on restrictive stocks favours sexual vigour or fertility. Hence this is a very valuable fact to the hybridist, and one which the young horticulturist will do well to remember. We graft our fruit-trees to render them more fertile; and it may some day be thought advisable to graft all our flowering shrubs, both hardy and tender, so as to render them more floriferous. As I have already observed, the power of the cultivator and hybridiser or cross-breeder, as the case may be, is immense, and the efforts of each or all tend

towards the same result—viz., the development of characters or qualities which are useful to man, and the suppression wholly or partially of all those we do not require. Culture means change, and change means motion; culture then means motion towards a superior standard of excellence. M. Naudin points out that motion is the transition of living organisms, as in plants, from one equilibrium or balance of characteristics, or state of repose, to another, and its course is begun by a breaking down of those characters which are weakest or which possess the least fixity; hence it follows that change in that direction becomes easier, inasmuch as the stronger characteristics have a better opportunity of progressing after the barriers which hitherto restrained them or kept up the equilibrium are destroyed or partially so by culture or hybridism. Given almost any variety of vegetable, fruit, or flower, and by the due regulation of its food—*i.e.*, moisture, light, heat, and air—it is in the cultivator's power to change it in size and flavour or in the period at which it arrives at maturity, and seedlings from it will also to a certain extent perpetuate the characters which culture has developed in the parent. To prolong the season of fruits, vegetables, and flowering or decorative plants, both early and late races are desirable; and if late-ripening varieties have the additional merit of being good keepers, so much the better or more useful do they become. A good constitution, especially in the case of hardy plants, is a great consideration, since this in general means increased hardiness, and easier, less expensive, and more extensive culture; one of the greatest of all drawbacks to the more general culture of Peaches, Nectarines, Apricots, choice Plums, and many other fruits in our climate being the prevalence of late spring frosts, which often in a single night destroy the fruit prospects of a whole season. Both English and French cultivators experience the effects of late frosts, although the latter rarely lose a crop, simply because they go to great trouble in sheltering their trees during the blooming season. Cheap as are glass structures at the present day, every one with a garden cannot obtain them; but by cross-breeding, our nurserymen might soon supply these cultivators with hardier and later-blooming varieties than those now generally grown. Cross-breeding is, however, not the only way in which we may obtain earlier or later varieties of our fruit-bearing or ornamental trees; for a tree or even a portion of a tree—a branch, twig, or even a single bud—is not unfrequently so affected by temperature, light, and other correlative causes, as to be earlier, later, or otherwise different from its fellows. Fruit from the "tops of the trees on the sunny side" is well known to be

larger and better in flavour, and frequently earlier, than that on the lower and shadier branches; and by taking due and intelligent advantage of this fact, we might possibly obtain earlier and later varieties of some of our finest and best-flavoured fruits.

The explanation of the unequal effect of the same degree of temperature is, according to M. de Candolle, owing to the buds of a tree being engaged in a perpetual struggle. Badly placed or imperfectly developed buds develop imperfect shoots. The earliest shoots have the advantage so long as they are not injured by frost. In this way a selective process and an adaptation of the tree to the climate are carried on. This is the more probable from the individuality possessed by the buds, and of which we avail ourselves in the operation of grafting. Thus M. de Candolle cites a case of a Horse-chestnut, near Geneva, which produces year by year, on a certain branch, double flowers. From this branch grafts have been taken which have furnished all the double Horse-chestnuts in Europe. Hence it may be concluded that certain branches may also be (as we know to be the case) earlier or later in development than others on the same tree, and that buds taken from these branches will preserve their characteristics when grafted. In the north precocity is sometimes advantageous, sometimes not so. In the south precocity seems generally beneficial, and yet it is in the south that species require the most heat to develop themselves. The principal cause of the difference in the vegetation of the north and of the south appears to be connected with the winter rest of plants. After a season of great external activity the plant loses its leaves and ceases to grow; but in the interior of the plant great changes and modifications of material are taking place at this time, in anticipation of the development of the buds at a subsequent date. In the north the internal activity of the plant is specially marked. This is one reason why heat acts more rapidly in the north than in the south. On the other hand, in southern countries, the plant continues to grow superficially, and a larger proportion of sap being utilised at the surface, there is not so much available for the buds in spring. The mechanical effects of the same amount of heat should be everywhere the same, but when it is exerted on different materials to transport or modify them, it is clear that the effect will be different. Such, in brief, is M. de Candolle's explanation of a phenomenon of which he has, by his experiments, given additional confirmation.

Careful study of nature will teach us much in the way of altering existing forms of vegetation. For example, climbing

or trailing plants have possibly been developed from plants of bushy or shrubby habit, which, having had to contend with more lofty and vigorous vegetation, as that of forests, have assumed a lengthened axis to enable them to climb or trail into the light and air. The common Ivy indeed assumes a bushy habit directly it reaches the extremity of the support to which it clings. Chinese and Japanese gardeners have long practised the art of dwarfing large-growing trees; and specimens so treated, only a few inches in height, bear leaves, flowers, and fruit in season, and form pretty little plants for decorative purposes. Taking these facts into consideration, it seems possible, by a careful selection of seedling plants or cuttings from the more shrubby branches, added to a regular system of careful pinching and exposure to light and air, to produce dense-habited or short-jointed shrubby and floriferous varieties of Stephanotis, Bignonia, Dipladenia, Jasmine, and other climbers; indeed, where desirable, this result has already been attained in Clematis and Allamanda. In the last-mentioned genus a variety named *A. Wardleana* was exhibited at South Kensington about 1867 or 1868, and plants only an inch or two in height, in small 60-sized pots, bore from two to six flowers each. This variety is the same, or nearly the same, as *A. Hendersonii*, a hybrid raised between *A. cathartica* and *A. Schottii*. A trial in this direction is well worth attempting; since climbing-plants, however graceful and useful in some situations, are inconvenient in others, owing to their straggling habit of growth and comparative paucity of flowers. One way of obtaining increased vigour in plants, and consequently greater power to ward off disease, is by changing their food and atmosphere as much as possible at frequent intervals; and in relation to this fact, it is interesting to note that many of our choicest vegetables, including Asparagus, Seakale, Cabbage (and its numerous forms), and Celery, are natives of our sandy sea-shores; and after growing for ages in poor soil and exposed positions, they have become succulent by cultivation and selection in the garden.

Cultivators as a rule do not pay sufficient attention to the careful selection of the plants from which they intend to save seeds. Careful and intelligent selection is, however, the only way to retain any good variety in its pure state, and neglect of this precaution often leads to a degenerate crop. Nor is this result confined to seeds alone; for as the individual branches, and even parts of branches or buds, are very variable even on the same tree, as great care should be taken in selecting buds or grafts from early or late, or fruitful and healthy

branches, as in the case of seed parents, this selection being to some extent regulated by the purposes for which propagation is effected, taste, or convenience, and in harmony with locality, soil, or climate.

Among plants the most likely to repay the labours of a careful hybridiser are those which bear male and female flowers separately, either on the same plant, as in Cucumbers, Melons, Oaks, and many Conifers, or on separate plants, as in the case of many Palms, Aucuba, Garrya, and others—in fact, nearly all monœcious and diœcious plants seem predisposed to hybridise freely with each other; and some other plants which, strictly speaking, are hermaphrodite, or have both male and female organs in the same flower, as in Primula, Linum, Lythrum, some species of Passiflora, and Forsythia, which are practically diœcious, since they never or very rarely fruit unless fertilised with the pollen from another species. Another large group of plants to which the intelligent hybridiser should direct his attention are the Orchids, Asclepiads, many Pea-flowers and Melastomads, the Lobelia family, Ericas, and indeed all others which, like those just named, show either by the curious structure of their blossoms or the functions of the sexual organs that insect agency is essential to their fertilisation. Other plants naturally favour cross fertilisation by the alternate development of the sexual organs in the same flower, and of these Agaves, Hellebores, and nearly all the Calceolarias are excellent examples. In the case of Calceolarias, the style is receptive long before the pollen is shed by the anthers of the same flower; and in Agave the reverse of this takes place, the stigma not being receptive or capable of impregnation until after its attendant anthers are withered. All plants which exhibit this irregular development of the sexual organs, like monœcious and diœcious plants, or such as require insect agency, rarely fail to repay the attention of the hybridist, and should be preferred for all scientific experiments, since the chances of accidental self-fertilisation are here reduced to a minimum. Orchids and Asclepiads are perhaps the safest of all plants with which to conduct scientific hybridising experiments. In all matters of propagation, whether sexual or vegetative, the idea of possible improvement should always be present in the propagator's mind. It is not enough to save seed and take cuttings merely to increase or reproduce a plant; but in all cases the selection of seeds, cuttings, grafts, buds, and stocks should be intelligently made, with the object of improving the future generation in addition to the mere fact of originating it. In other words, do not let the brain be led by a dexterous hand, but, above all, let the hand, however

clever in itself from force of habit, be guided by a mind bent on bettering or improving the individuals to which life, or a separate existence, is to be given.

Notwithstanding the enormous strides made in the improvement and variation of our florists' flowers, fruits, and vegetables, there yet remains a wide field for further improvement. Hybridisers and cross-breeders work too much in the same groove, one following the other. No sooner does a Dominy, a Seden, a Bause, a Rivers, or a Laxton originate a new race of flowers, fruits, or vegetables, than a host of imitators set to work on the same plants, and we are surfeited with tens or hundreds, as the case may be, of seedlings which resemble each other so closely that we are bewildered with a host of indefinite forms, and turn with a sigh of relief to the old species or types. It was so with Fuchsias, Calceolarias, Pelargoniums, Coleus, Caladiums, and it is equally as bad in the case of such vegetables as Peas, Potatoes, different kinds of the Cabbage family, and Cucurbits. What we really do want is original work among distinct types not yet hybridised; and there is not the slightest reason for the cultivator to confine his experiments solely to garden-plants, since those of the farm and the forest are equally useful, and in many cases more permanently beneficial.

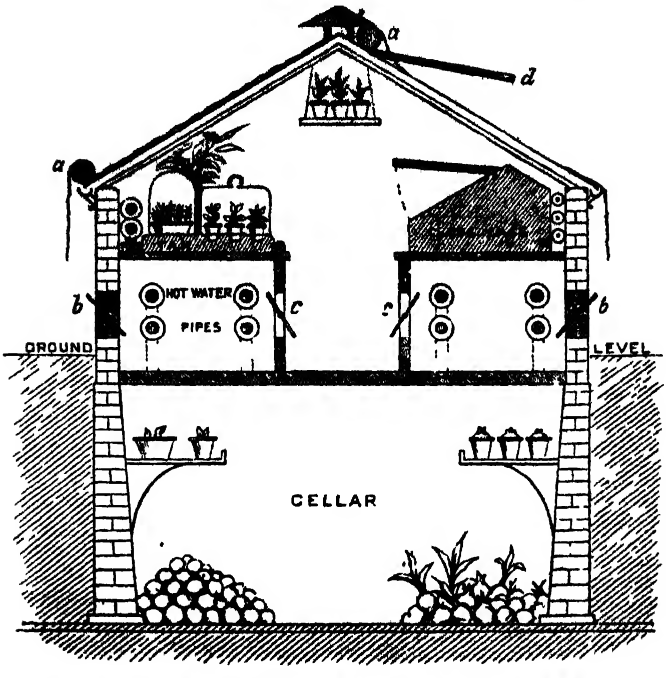
PROPAGATING HOUSES AND PITS.

"Who loves a garden; loves a greenhouse too."—COWPER.

IN many small private gardens, no separate structure is required for propagating purposes, one of the vineries or cucumber-pits affording all the requisite accommodation—a common garden-frame, or a reduced form of it, being employed for tender cuttings, or for choice seeds which require a close and humid atmosphere. In large gardens, however, the propagating house is, or ought to be, a separate one; and in the hands of an intelligent cultivator it is at once one of the most interesting, and at the same time most profitable, of all garden structures. The size of the house must, of course, depend on the requirements of the place; but it is advisable to have a partition in the centre, and the hot-water apparatus should be so arranged that both divisions can be heated separately, and while one is kept at a tropical heat, the other may be of a greenhouse temperature, so as to serve for the multiplication of hardy and half-hardy trees, shrubs, annuals, or herbaceous plants. Span-roofed houses are the best, but a lean-to house or pit also answers well. The hot compartment will not require so much air as the cool end, but it is always advisable to provide ample ventilating apparatus at the time such structures are erected. As to aspect, a position due east and west answers well, and it should be sheltered from cold winds. As a rule, the closer and more genial propagating houses are the better, and building them partly below the ground-level not only renders them naturally less liable to suffer by external changes of temperature, but also by the same token saves fuel. Neat little span-roofed houses, partly—say two feet—below the ground-level, are generally the most satisfactory. As to the dimensions, they can be made to vary according to circumstances of site and other peculiarities of situation; but a house twelve feet wide, and eight to ten feet high at the ridge, is a convenient size, and generally suitable. As we have said,

warm and cool compartments are desirable; but where operations are to be extensive, separate warm and cool houses may be erected. As a rule, it is best to heat the propagating house from a separate boiler, of which the propagator or his assistant takes full charge at least during the day; but in many cases, and especially in private establishments, it may be heated along with the other houses. It should always be borne in mind, however, that the inmates of the propagating house are peculiarly delicate and sensitive to any extremes of temperature, and ample heating power should always be provided, to prevent future accidents and disappointments. Shading materials are of peculiar value to the propagator; and apart from the usual shading material—*i.e.*, stout canvas mounted on wooden rollers, to be worked by a pulley outside the house—particular portions of the house or pit often require to be shaded with canvas or mats, and low houses partially below the ground-level are in these cases very suitable. At one end of the house or pit it is convenient, if not actually necessary, to have a potting or propagating shed, and this should also be heated with hot-water pipes, so that no injury may be received by the young plants and seedlings which are brought here to be pricked out or potted off. This shed should communicate directly with the warmest end of the house, and should be fitted up with benches, bins for soil, sand, peat, crocks, &c., shelves or compartments for pots, pans, bell-glasses, tools, and other appliances; while a shelf or cupboard may be added to contain memorandum-books, catalogues, and delicate implements. A nest of drawers for seeds should be added, and the amateur may also add a small library of books treating of the plants he most admires. Here also hot and cold water should be obtainable. As to the fittings of the house itself, little need be said except that a path down the centre at least a yard wide should be left, and brick side benches about four feet wide, constructed on either side, as shown in our illustrations. Cases or frames, tan beds, and shelves near the glass, should also be provided. One of our sections represents a very useful propagating house, constructed over a cellar,—an arrangement much to be recommended wherever practicable, as the body of air thus obtained below the house conduces to a more regular temperature, and at the same time it is very handy for preserving or in which to store bulbs, tubers, &c., throughout the winter months. A cellar of this description is always secure from frost, and is especially useful for storing Cannas, Solanums, and many other subtropical or flower-garden plants, as also for Hippeastrums and other deciduous bulbs, Gloxinias, Gesneras, Achimenes,

Tydæas, and even for selected vegetables for seed purposes, such as Carrots, Beet, Potatoes, Parsnips, Salsify, and many others. The walls of the cellar are sloped inwards buttress-like, so as to better resist the pressure of the soil from without; but, if preferable, the walls can be carried down straight, and buttresses formed at intervals. The roof of the house is shaded when necessary by canvas rollers (*a a*)—these being



Propagating House with Cellar beneath in which to store Dahlias, Mirabilis, and other Tubers

rolled up under the terminal coping by cords which work over pulleys 8 inches in diameter fixed at the ends of the rollers. The outer ventilators are shown at *b b*, and through these air is admitted into the chambers beneath the stage through which the hot-water pipes are conducted for bottom-heat; while through the valves at *c c* the heated air can be admitted into the atmosphere of the house, the heated air of which escapes through the ventilator at *d*, over which a sheet of wire gauze

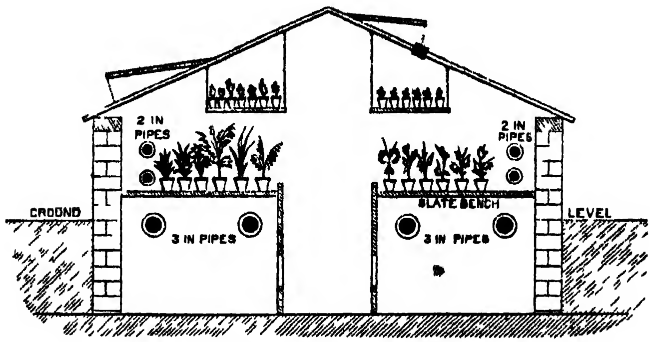
or perforated zinc is stretched to prevent draughts of cold air from without, and also to exclude insects. The outer walls should be at least 9 inches thick if solid; but a still better plan is to build the wall hollow in the centre, so as to enclose a stratum of dry air, the cold or frost resisting properties of which are well known. The wall-plates and rafters should be of the best red deal or pine, well painted, and the whole glazed with 21 oz. glass free from specks or rings. Common white deal rafters and wall-plates, although cheaper in the first instance, soon commence to decay when subjected to a hot humid atmosphere. The internal fittings and arrangements are self-explanatory. Access to the cellar can either be made from the shed or stoke-hole at one end of the structure, or by a trap-door in the floor of the house, a short ladder or pair of steps being used to effect the descent.

As a rule, the propagating house or pit is a kind of *sanctum sanctorum*, a holy of holies, into which the high priest alone—*i. e.*, the propagator—or other responsible person, is allowed to enter; and this is almost a necessity in most cases, since the thoughtless plucking of a single flower may destroy the hopes of months, and perhaps years. Apart from its use in the way of raising seeds, rooting cuttings, or as affording the requisite conditions for insuring the success of delicate surgery and manipulation in the way of grafting, budding, or inarching, the propagating house is generally selected as the best place for conducting experiments in the crossing or hybridisation of tropical plants, and it thus becomes a most attractive source of recreation to the intelligent horticulturist, be he master or man. The ventilators of houses used for hybridising experiments should be covered with wire gauze or perforated zinc, so as to exclude bees and other honey-seeking or pollen-eating insects. Give an earnest hybridiser a snug little heated pit or house about the size of a saloon railway carriage, and what has he not in his power to accomplish in the way of originating new forms of vegetation! In trade establishments, small span-roofed houses are added to the propagating department, and in these the young cuttings, seedlings, or grafted plants are grown on for sale.

Most plant-growers are aware of the good results attainable in low span-roofed structures where every plant is close under the glass, and consequently fully exposed to the light. Our market-growers, who produce hundreds of fine sturdy little flowering-plants for the London markets every week during the season, appreciate these structures very highly; and the best of them are content with these low houses, and a series of

cool pits and frames for hardier plants. In some cases they may be sunk partly below the ground-level with advantage, but this is scarcely necessary except in exposed or bleak positions. If there is no propagating pit on the premises, one of these houses makes an excellent substitute with the aid of a few small one-light frames, or even a few bell-glasses or common hand-lights; while for growing on young fresh-rooted plants they are just the thing.

Our engraving illustrates in section one of these economical structures, which, for all practical purposes, are ten times more useful to the amateur who really wishes to grow or improve plants than the fancy greenhouses usually attached to villa and suburban residences, and in many of which a clever professional gardener could not grow plants successfully. One



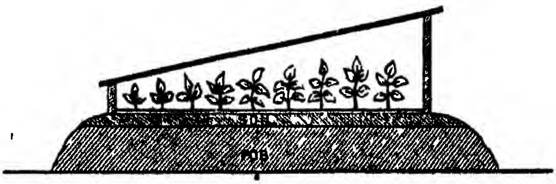
Section of span-roofed Propagating and Hybridising House

of these little structures thirty or forty feet long is amply sufficient for the requirements of most amateur hybridisers, and a little compartment can readily be partitioned off at the warmest end, and heated with an extra row of pipes; this will serve all the requirements of a propagating house in a small private garden.

For the multiplication of conifers, hardy evergreen or deciduous shrubs and trees, either from cuttings or seeds, low frames or brick pits are often of great service; and even turf pits covered with canvas stretched on wooden frames may be turned to good account for various propagating purposes.

Our illustration (p. 22) shows one of these low frames, much used by nurserymen and others in the North of England and Scotland, where they are placed on a bed of flax refuse or

"pob," the latter being, say, a foot or eighteen inches thick. Over this substance a few inches of fine sandy compost is placed to receive the seeds or cuttings. Beds made of "pob" retain their gentle and regular heat for several months, the only difficulty being to get the refuse flax thoroughly moistened, either with warm water or steam, previous to its being used. These low frames are very useful for raising seedling Rhododendrons, Aucubas, Araucarias, and many other handsome ornamental



Pob Frame

garden or forest trees or shrubs; and in every garden they deserve a place, as, when not wanted for propagating purposes, they form admirable shelter for choice alpine and herbaceous plants in pots. For the propagation of many herbaceous plants from cuttings—and especially for Auriculas, Pinks, Carnations, Pelargoniums, Pentstemons, Wallflowers, Phlox, &c.—light wooden frames covered with oiled tea-paper are very useful, as they economise sun-heat by preventing radiation during the night; indeed, in this respect they are superior to hand-lights.

SEED-SAVING AND SEED-SOWING.

"Throughout the earth the gospel preached by nature to man is that of growth. This is the glorious marvel that is ever with us. Seed-grain climbing to waving harvest, acorn springing up to towering oak; black coal crystallising to diamond, and flint gathering the heat of the earth, till as opal it meets the dawn with tints pure as its own; while on every lowliest grass blade and leaf is written the story of ascension."

DOUBTLESS many will look here for instructions as to the general management of seeds, for few things are more perplexing to the amateur cultivator. How shall I sow my seeds? or when is the proper time to sow Wallflowers? and hundreds of similar questions, are annually received by the patient editors of our horticultural journals; and it was partly to meet cases like these that the present section was written. The management of seeds may be considered under two heads—seed-saving and seed-sowing, and we shall commence with the first-named branch of the subject.

SEED-SAVING.

It was formerly necessarily the practice of all horticulturists to save their own seeds, but it is now quite optional whether they do so or not, as the nurseryman includes it as a very important branch of his business; and it is frequently both better and cheaper to buy seeds than to save them. Most of our principal seedsmen have extensive seed-farms in favourable parts of the country, where great care is taken to keep the sorts or varieties pure by weeding out bad varieties, or "rogues," from the seed-bearing plants. This careful selection of seed-bearing plants is an important matter; for if plants were left to themselves, and seed gathered indiscriminately, the strain or variety, no matter whether flowering-plants or vegetables, would soon degenerate or revert towards the type or species from which it had been originated. In the case of Cabbages, Broccoli, Turnips, and other plants which are easily altered by cross-fertilisation, it is necessary to grow the varieties quite

separate from each other; and it is a common practice to send the seed to different parts of the country, where it is grown in a field or plot by itself that is quite separate from any other brassicaceous plants, otherwise the variety would become deteriorated, just as is the case when several kinds of Melons or Cucumbers are grown in the same house or frame. Sometimes, however, as is well known, this promiscuous interbreeding results in producing one or more new forms of even superior quality; but even this does not compensate for the loss of a valuable and known strain of uniform quality which is much wanted, and perhaps bespoke or sold while in the seed-beds. Many flower-seeds are grown on the Continent, especially in Germany; indeed the Prussian seed-farms at Erfurt are well known for their excellent strains of Stocks, Primulas, Balsams, Asters, and many other popular flowers. The Erfurt strains of Asters are very fine; and the seeds of Asters, as well as most other Composites, ripen better under a hotter sun than ours, as they are extremely liable to suffer from dampness in the atmosphere. Good culture, added to careful selection, does much to insure good seeds; and as many plants produce more seeds than they can ripen properly, it is an excellent plan to remove or thin the flower-spikes, or take off their tips when flowering, so as to throw all the vigour of the plant into those that remain. This is often done in the case of Wallflowers, Stocks, Clarkias, and similar plants; and the result is perfect seeds, which are found to produce finer or a larger proportion of double flowers than those left to chance. In the case of double-flowered plants, if we except Fuchsias, the seed has necessarily to be gathered from either single or only partly double flowers; and it is best to gather the seed of such flowers as are semi-double, as this shows their tendency towards the desired quality. Thus, from the seed-beds of Stocks, all perfectly single varieties are carefully weeded; and the same is practised in the case of Balsams and other annual plants in which double flowers are most highly prized.

We have alluded to the great care necessary to keep any distinct variety pure, or what is technically termed "true to name;" but in many cases this cannot be done, and then the energy of the cultivator is directed towards obtaining and preserving by selection what is called a "good strain." In plants which vary very much from seed, such as Calceolarias, Cinerarias, Chinese Primulas, Balsams, Zinnias, Asters, and many other annuals, it is impossible to do more than save the seed

from good varieties of compact habit, which themselves bear large, well-formed, and distinctly-coloured flowers. This is the plan adopted by the market-growers who supply Covent Garden with flowering-plants, as well as by those florists who grow seeds for sale or trade purposes. In this case a house or pit is devoted to the seed-plants, which are picked out of the entire stock grown, great care being taken in their selection. These plants are set near together, and are crossed by the breeze or by the bees; and in this way a great variety of very beautiful flowers, scarcely two being exactly alike, may be obtained. Messrs Smith & Sons of Dulwich save from a pound to a pound and a half of Cineraria seed every year, and a proportionate quantity of Calceolaria seed. This is considered a large quantity, and several large pits are devoted to the seed-bearing plants; but then it must be borne in mind that good Cineraria or Calceolaria seed is worth from £10 to £15 per ounce, and Primula seed even more, if it is known to be saved from a first-class strain. From a houseful of Fuchsias, Mr H. Cannel—who is well known for his new varieties of this favourite plant—only obtains about a quarter of an ounce of perfect seed, the value of which cannot be calculated, as it is never sold. The seeds of many plants are gathered indiscriminately, but these are principally for the propagation of hedge plants, such as Hawthorn, Holly, &c, and such forest-trees as Oak, Ash, Sycamore, Pines, Firs, and other Conifers, but in the latter case, care in selecting acorns, keys, or cones, is not to be lightly thought of.

Many Conifer seeds are now imported from California and other parts of North America, and these imported seeds are by many considered superior to those of home growth—(see Conifers). Soft or pulpy fruits, such as Strawberries, Raspberries, Blackberries, Gooseberries, Currants, and others of a similar character, are rarely propagated from seed, although one can scarcely imagine such fruits to be perfect, or so near perfection as they might yet be made by cross-breeding and more careful selection. American horticulturists have much improved their native Blackberry both in size, fruitfulness, and flavour, yet we neglect such a wholesome fruit here at home. Keen's Seedling Strawberry was a few years ago considered the best for fruit-growers as a main crop for market, but it is now far surpassed by half-a-dozen others; and even the antipathy of the deliciously-flavoured British Queen to some soils might be overcome, one would think, by a little care in cross-breeding, or perhaps raising directly from seed.

There is undoubtedly a limit to the improvement of most fruits; but Currants like Grapes in size, and Gooseberries of similar proportions to a small Melon, are not impossible, one would think, judging from the results already obtained. Attention to gather or harvest seeds in dry weather, and just as soon as they are perfectly ripe, is essential. Many seeds contained in dry pods or capsules are separated by beating or by rubbing in the hands. Pulpy fruits, as Melons, Cucumbers, bush fruits, and Strawberries, require different treatment. Some separate the seeds from the pulp by washing and straining in clean water; but it is advisable to do without this if possible, as, unless the seeds so separated are very carefully dried in the sun or before a fire, they turn mouldy and decay—that is, unless grown at once. I have adopted the following plan in clearing Cucumber and Melon seeds; and it is equally applicable for all pulpy fruits, if the quantity to be separated is not very large. Cut open the fruit and separate the seeds as cleanly as possible with the fingers, laying them on a coarse dry towel, in which they are to be rubbed until dry. The pulp quickly becomes absorbed by the cloth; but in some cases two towels may be necessary, one to absorb the bulk of the slimy pulp, and the other to thoroughly dry the seeds. Seeds so treated, and exposed for an hour in the sun on a sheet of paper, may be at once wrapped up and put away without any fear of mildew or mouldiness. Most dry seeds, as Cabbage, Turnips, and flower-seeds, are winnowed or cleaned by machinery ready for the market. It is as well to bear in mind that all seeds should be saved from the most perfect plants of their kind; and they should be harvested as soon as they are ripe, and in dry weather. Thinning seeds, where it can be conveniently done, is as essential to the production of plump, well-developed seeds, as thinning Peaches or Grapes conduces to finely-developed fruit; while suitable soils and good cultivation are just as important in one case as the other; yet we often hear the half-contemptuous expression, "Oh, I only stuck them in there for seed!" All seeds are best left on the plants until they are ripe, but some plants do not ripen all their seeds at once; hence, as in grain, some are cut when comparatively green, but with considerable stem attached, and those seeds are as good as, in fact germinate more freely and sooner than, those left to nature upon the growing plant. The seed in such cases should be fully formed, and is better if kept in the husk or pod until ready for sowing.

SEED-SOWING.

It is simply impossible to do more than speak generally on this subject, than which, perhaps, there is none more perplexing to the amateur horticulturist. When, how, and where shall I sow? are questions which occur to every one who receives seeds of which he knows nothing whatever, or very little, as the case may be. The experienced horticulturist is well up, as a rule, in the temperature and other conditions best suited to the germination of the seeds of most garden-plants; and when he obtains unknown seeds from abroad, he, from past experience and experiment, seldom fails, if they are in good condition. All I shall here attempt will be to give such general instructions on seed-sowing as may be useful to the young horticulturist and to inexperienced amateur cultivators. "How deep shall I sow my seeds?" is a very common question, and one not difficult to answer, since it depends mainly on the size of the seed and constitutional vigour of the plant A depth of about two inches is sufficient for the large seeds of such strong growing plants as Peas, Beans, Cereals, and others of a similar character, indeed there are scarcely any seeds which should be sown deeper, in the open ground, than this For such medium sized seeds as Onions, Lilies, Tulips, Hyacinths, Cabbage and other Brassicas, Carrots, Antirrhinums, Sweet Williams, Wallflowers, and hardy annuals, a depth of from half an inch to an inch is amply sufficient—half an inch if they are small, and about an inch if large Dr Regel has demonstrated that the covering of soil is only necessary to preserve an equable condition of moisture around the seeds If some of the finest and smallest seeds—as, for instance, those of Calceolarias, Ericas, Rhododendrons, Epacris, &c—are sown on the surface of the soil, and an equable condition of moisture maintained by covering the pot with a pane of glass, the seeds will germinate in the full sunshine much better than if they had received a slight covering of soil. This is a plain proof that absence of light is not absolutely necessary for the germination of seeds. The smallest seeds—those like fine gunpowder or sand, of which Primulas, Calceolarias, Gloxinias, Pinks and Carnations, Sweet-Basil, and many others, may be mentioned as examples—scarcely require to, and indeed should not, be covered at all; and it is principally with delicate seeds, like those just mentioned, that the amateur fails. All very small seeds, even if hardy, are best sown on the surface of

well-drained pans of fine moist earth, and placed in a cool frame or in heat, according to the season of the year and the hardiness of the plant. Some prefer to water the compost first and then sprinkle the seeds on the moist surface, while others prepare the pan and sow the seeds on the smoothened surface, and then press them with a flat bit of circular board like that used to smooth the sand on the surface of pots for fine hard-wooded cuttings; and as it is next to impossible to water fine seeds like those named with the finest rose without displacing them or washing them away, it is best to plunge the pot or pan for a minute or two in a shallow vessel of tepid water until the whole body of compost becomes moistened by capillary attraction. In both cases, a covering of damp brown paper or canvas is spread over the pot or pan, to prevent the soil from becoming dry by evaporation before the seeds germinate. Some use a light covering of damp moss for the same purpose; but paper, or a sheet of glass, is much handier, and decidedly the best. Care should be taken to remove the paper or moss as soon as germination is observed to have taken place. The great essentials to the growth of seeds are heat and moisture together with air, and darkness is often advisable (if not actually necessary) until the young seedlings appear above ground. Nearly all seeds, even those of hardy plants, germinate best in a moderate heat of, say, 50° to 60°, with a humid atmosphere, notwithstanding that the seeds of some plants, as Groundsel (*Senecio*), Chickweed (*Stellaria*), or Shepherd's Purse (*Capsella*), will germinate readily in the open air during the winter season, or when the thermometer is only a degree or two above the freezing-point. As a general rule, the seeds of all plants germinate better in a temperature at least ten degrees above that in which the plant grows naturally. The seeds of all hardy and half-hardy plants grow freely in a genial airy temperature of from 50° to 65°. Intertropical plants, or such as require the protection of a warm greenhouse for most part of the year, should be sown in a heat of from 65° to 80°; while seeds of stove-plants, from the warmest parts of the world, should be sown on a genial bottom-heat of 75° to 95°. Dr Regel gives the following information as to temperatures: The minimum temperature at which germination takes place is from 38° to 40° for Lentils, Clover, Lucerne, Wheat, Barley, Rye, Mustard, Radishes, and Cress; 43° for Carrots, Broad Beans, and Spinach; 45° for summer-blooming plants; 48° for Buckwheat and Maize; 50° for Beans, and 55° for Pumpkins. The maximum temperature at which germination takes place is

112° for Cress, Pumpkins, and Maize; 110° for Beans; 104° for Broad Beans, Wheat, and Barley; and 102° for Peas. In such annual plants, the nearer the temperature approaches the maximum the sooner will the seeds germinate; for instance, Maize germinates in thirty to thirty-five days, in a temperature of from 45° to 56°; in twenty to thirty days, 67° to 75°; in seven to eight days, 90° to 100°; Barley in forty to forty-five days, in a temperature of from 35° to 45°; in twenty to twenty-five days, 55° to 60°; in ten to twelve days, 94° to 100°. For tropical seeds we have named a temperature of from 70° to 90°, but there are some seeds which require a still greater heat to cause them to germinate; for instance, the seeds of the gigantic Water-rose of the Amazon river require a heat of from 95° to 105° before they will germinate.

If seeds are to be sown as soon as they are gathered, it is as well to observe that the germ or embryo of the seed is fully capable of perfect germination long before the seed has arrived at that perfect state of ripeness or maturity which is necessary to insure its keeping properties; and if seeds are gathered at the first stage, or sown as soon as the embryo is perfect, they germinate much quicker than when perfectly ripe. We see illustrations of this fact in wet seasons, when the seed of cereals frequently germinates in the ear. The reason that young seeds, or seeds sown directly they arrive at that stage of perfection when healthy germination is possible, grow more quickly, is because they contain less carbon than those perfectly hardened and dry, for the more carbon a seed contains, other things being equal, the longer that seed is in germinating, because it must get rid of a large proportion of that stored-up carbon ere it will grow, or, in other words, after nature has stored it with sufficient carbon to insure its keeping power for one or more years, certain important chemical changes must take place before it can develop leaves and roots. Naturally, when a seed falls or is sown in moist earth, it absorbs water from the soil, and also decomposes it, if the seed is in a healthy state; but if the seed is unhealthy, its tissues, instead of separating oxygen from the water, and thus getting rid of the superfluous carbon in the form of carbonic acid gas, become clogged with superfluous moisture, and rot. Moisture, then, is one of the greatest aids to germination, but the amount of moisture essential is a most important point. Strong-growing, healthy seeds may be placed in a shallow vessel and covered with water until germination takes place, when they may either be potted or planted out in the soil; but, on the other hand,

this treatment would be certain death to many delicate seeds, which will not germinate unless sown on the surface of moist compost, and covered over, so that they are surrounded by water in the state of vapour,—a method commonly practised with such delicate seeds as Primula, Gloxinia, Gesnera, Calceolaria, and Achimenes. Whenever healthy seeds rot instead of germinating, in nine cases out of ten excess of moisture in the soil, or irregular application of heat and moisture, has caused such a result; and it may be taken as a rule that, the smaller and more delicate the seeds sown, the less moisture is essential in the soil in or on which they are placed. In the case of old or unhealthy seeds, the best plan is to sow them in dry soil, placing them afterwards in a genial heat and moderately humid atmosphere, where they should not be watered until signs of germination appear. In this way the seeds are gradually supplied with moisture by the powers of absorption or attraction possessed by all soils in proportion to their dryness when placed in the moisture-laden air; and this plan will be found to succeed where any other fails. It is customary to steep many strong-growing seeds, in order to facilitate their germination; and seeds with very hard coats may be immersed in water heated to 200° Fahrenheit,—the object in this case being to partly decompose or loosen the tissues of the hard seed-coat, and thus stimulate the seed to make a quicker growth.

Autumnal-harvested seeds from cold and temperate latitudes, even when placed in suitable conditions as regards heat and moisture, do not germinate so readily as if they had previously been more fully exposed to frost and moisture; and on this point Dr Regel remarks that these natural conditions of exposure appear to have the effect of disintegrating the nutritive matter or carbon of the cotyledons, and so hastening the germination of the young plants. In a state of nature, Alpine plants, and many of the plants of Northern Europe and Asia, are sown in the snow; and this is especially true of Primulas, Azaleas, Gentians, many kinds of Pinks, to say nothing of Willows, Brambles, Roses, and other forms of northern vegetation.

"Exposed to the influence of water, heat, and air, the parts of a seed soften and distend; the embryo swells and bursts its envelopes, extending the neck and bases of the cotyledons, and finally emitting its radicle (root), which pierces the earth, deriving its support at first from the cotyledons or albumen, but subsequently absorbing nutriment from the soil, and communicating it upwards to the young plant. The manner in which

the embryo clears itself from its integuments differs in various species: sometimes it dilates equally in all directions, and bursts through its coat, which thus becomes ruptured in every direction; more frequently the radicle passes out at the hilum or near it, or at a point apparently provided by nature for that purpose, as in Canna, Commelina, &c. If the radicle has a root-sheath, this is soon perforated by the radicle contained within it, which passes through the extremity, as in grasses and most monocotyledonous plants. The cotyledons either remain underground, sending up their plumule from the centre as an oak, or from the side of their elongated neck as in monocotyledons; or they rise above the ground, acquire a green colour, and perform the ordinary functions of leaves, as in Radish and most plants. In the Mangrove, germination takes place in the pericarp (or fruit) before the seed falls from the tree; a long thread-like caulicle is emitted, which elongates till it reaches the soft mud in which such trees usually grow, where it speedily strikes root and separates from its parents. *Trapa natans* has two very unequal cotyledons; of these the larger sends out a very long petiole, to the extremity of which are attached the radicle, the plumule (or young stem), and the smaller cotyledon. Cyclamen germinates like a monocotyledon; its single cotyledon does not quit the seed till the end of germination, and its caulicle thickens into a fleshy knob which roots from its base. The Cuscuta, which has no cotyledons, strikes root downwards and lengthens upwards, clinging to anything near it, and performing all the functions of a plant without either leaves or green colour of its own. In monocotyledons the cotyledon always remains within the seminal integument, while its base lengthens and emits a plumule. In Cycas, which has two cotyledons, the seminal integuments open and the radicle escapes."—(Lindley.)

From the 'Flore' we learn that two chemists of the Academy of Brussels, Messrs Dehéian and Ed. Landrin, have made some interesting discoveries relative to the germination of seed. It is well known that the action of the air and the presence of water are necessary conditions; but hitherto the mode of action of these two agents has not been fully understood. MM. Dehéian and Landrin have been enabled to throw some light on these mysterious phenomena. It is now ascertained that the effect of water is to soften the covering of the seed so as to render it permeable by gas. When they have imbibed sufficient moisture, the tissues of the seed acquire the property of condensing gases. This condensation cannot take place without

producing heat; the oxygen, therefore, which has penetrated the tissues is sufficiently heated to cause oxidation, and the consequent awakening of vegetable life. According to the experiments of MM. Dehéian and Landrin, the condensation of the gases in the seed is the first commencement of germination. If this condition is not produced, whether from want of water or because the air cannot reach the seed, there can be no formation of the immediate principles necessary for the evolution of the germ. These experiments, although highly scientific, are very interesting from a practical point of view, as they enable the cultivator to determine the influence which the solidity of the soil, the dryness or the excess of moisture, the depth of earth in which the seed is placed, may have on the success of the sowing. Experience has already taught us much on these matters; but scientific methods, corroborating as they do the observations of practical men, can alone point out the sure means to be employed to bring about desired results.

A weak solution of alkali quickens the growth of some seeds, and lime-water has been recommended as a steep for cereals, coniferous, and other seeds; but it must be used in a weak state. The secret of success in using lime would seem to be its affinity for carbonic acid, which it extracts from the seed, and thus induces a more rapid germination than the application of heat and moisture alone. Humboldt employed a weak solution of chlorine, which possesses the power of decomposing water, and thus setting oxygen at liberty; and diluted oxalic acid has been successfully used in the case of very old seeds. Camphor has long been said to possess the property of hastening the germination of seeds, and similar properties have been attributed to bromine, chlorine, and iodine. M. Heckel has recently experimented with these substances, and the results go towards proving the correctness of this assertion. Radish-seeds, simply moistened with pure water, germinated in eight days; similar seeds, kept moist with iodine water, germinated in five days, with bromine water in three days, and with chlorine water in two days. The monobromide of camphor exhibited even greater quickening energy than either of its constituents used separately, or than a simple mixture of bromide and camphor, germination occurring after a mean interval of thirty-six hours. Alkaline borates and silicates, on the other hand, were found to retard germination, even when used in relatively small proportions; stronger solutions checking germination for an indefinite period. Arsenious acid and the

soluble arseniates prevented germination altogether by destroying the germ or embryo.

Heat assists germination by quickening the action of the tissues; and darkness is favourable to the liberation of the carbon and the formation of carbonic acid gas,—a process which takes place in the growth of all seeds. The relative length of time in which seeds germinate is very variable; some, as Mustard, Cress, and Radishes, for example, appearing above the earth a few hours after they are sown, while other seeds lie in the ground for years. Seeds of many hardy trees and shrubs, as Conifers, Hawthorn, &c., germinate the first or second year; while, if the ground is left undisturbed, straggling seedlings make their appearance for years afterwards. Some seeds will germinate after having been kept above ground for many years, while others fail to grow the second year,—and the fact is as unaccountable as it is true. Seeds buried deep in the earth—that is, below the effects of air and external temperature—retain their vegetating power for lengthened periods, and spring into life again when brought near the surface, so as to be influenced by heat and air. Evidence of this is afforded by the deep cuttings made for bridges and railways in nearly all parts of the country; and it will be found that the botany of railway embankments is often far richer than the adjoining country.

The quality and size of seeds, as pointed out many years ago by Mr T. A. Knight, demand some attention, since on these points the success or failure of a crop in a great measure depends. Dr Gustav Marck has recently published a valuable paper on this important subject, embodying the results of a great number of experiments made by him at the experimental stations at Halle and Leipsic. Most convincing proof of the superior value of large seed is furnished by the results of some of his experiments in the garden. Beans and Peas were planted in the garden, small and large seeds of each kind being planted on adjacent plots, the Beans 12 inches apart each way, and the Peas in rows 10 inches apart and 2 inches asunder in the row. The crop was carefully harvested, and measured when ripe, and the progress of growth was closely watched during the season. The larger and more uniform growth of the plants from the larger seeds, from the beginning to the end of the season, is shown in the condensed tabular form in which we have arranged the results of these experiments. Height is given in inches, and weight in ounces, if not otherwise specified.

Beans.	Plants from— Large Seed.	Small Seed.
May 23.—Height of plants,	6—8	3—9
Average number of leaves,	8	6
June 9.—Height of plants,	12—5	10—11
June 11.—Number of plants in bloom,	45	12
June 17.—All the plants in blossom. Ten average plants taken up from each plot. Average height of plants,	24	20
Average number of leaves on each plant,	13	11
Aggregate weight of the ten plants when dry, in grains,	837	576
July 31.—Pods fully formed. Whole number of pods,	3138	2799
Aug. 5.—Crop harvested. Total weight of haulm and pods,	219	183
Weight of seed, first quality,	162	121
Weight of seed, second quality,	6	25

In whatever way the plants are compared, and however minute the measurements that are made, the advantage remains always with the plants from the large seed. The much greater uniformity of growth cannot be shown in the table without taking too much space, but it appears all through the details given in the original paper. To give one or two instances: Of the ten plants taken up on June 17, all but one of those from the large seed had its leaves as given in the table, and the odd one had twelve leaves; on the other hand, of the plants from the small seed some had ten, some eleven, and some twelve leaves, and one had thirteen. The uniformity of the plants from the large seed was marked. At the rate given in the above table, the increased yield per acre of seed of the first quality that may be obtained by the use of large seed rather than small would be 250 lb. A similar course of experiments with Peas gave the following results:—

Peas.	Plants from— Large Seed.	Small Seed.
May 23.—Height of plants,	6—8	4—5
June 6.—Height of plants,	18	10—12
June 19.—Ten average plants taken up from each plot:		
Average height of these plants,	44	34
Average number of leaves,	15	13
Average weight of the ten plants, green,	11—5	9
Ditto, dry,	2	1—6
July 26.—Crop harvested:		
Total weight of haulm and pods,	201	192
Weight of seed, first quality,	48—5	19
Ditto, second quality,	19	37

In the case of the Peas as well as of the Beans, the plants from the larger seed were better throughout the season than those from the small seed: the superiority of the former was specially marked in respect to the quality of the seed harvested, as shown in the table. Professor Lehmann, of Munich, carried out a somewhat similar course of experiments with the same plants, and with still more striking results in favour of the use of large and carefully-selected seed; and in his experiments not only did the larger seed yield a larger crop from the same number of plants, but a much larger proportion of the small seed failed to germinate in the garden, or at least to push the young plants to the surface of the ground, than of the large seed.

At the January meeting (1876) of the Edinburgh Botanic Society, Mr Stephen Wilson read a very interesting paper on "Turnip Seeds;" and his experiments also go to prove that large, plump, well-ripened seeds are the best in every way. Even in the case of tubers used for "sets," as with Potatoes, the same rule holds good. Mr Maw, in his Prize Essay on Potato-Culture, read before the Society of Arts, points out that the larger Potato "sets" are, up to 8 ounces each, the finer and heavier is the crop.

Large, heavy, well-ripened seeds secured, a careful mode of sowing must not be lost sight of; and as the object of sowing is to obtain the largest and best crops from a given area, it follows that the system which secures this end is the best. One of the evils most to be dreaded is sowing too thickly. Just the quantity of seed to secure a good crop should be sown, and no more. The seedlings should never be so close together that they are brought into competition for food and air; indeed, all cases of thick-seeding or overcrowding are so much power lost—loss of seed, loss of labour in thinning out, and loss of nature's greatest power, that of growth. In the case of large seeds, dibbling is perhaps the best of all modes of sowing.

The following table on the duration of the germinating power in seeds was originally published in the 'Revue Horticole,' and may be useful to those who are uncertain whether to sow old seeds or not. The figures indicate the number of years in each case in which the seeds named may be depended upon as preserving their vitality or power of growth. In many cases the power of growth is preserved much longer than here stated.

Artichoke (Globe)	5	Dandelion . .	1	Pepper (Long) .	4
Asparagus . .	4	Egg Plant . .	7	Potato . .	4
Basil . . .	6	Endive . .	8	Purslane . .	8
Beans (Garden) .	6	Fennel . .	6	Radish . .	5
Beans (French)	2-3	Gourd . . .	5	Rampion . .	5
Beet . . .	5	Leek . . .	2	Rhubarb . .	3
Burnet . .	2	Lettuce . .	5	Salsify . .	2
Cabbage . .	5	Maize . . .	2	Savory . .	3
Cardoon . .	7	Melon . . .	5	Scorzonera . .	2
Carrot . .	4	Mustard . .	5	Sorrel . . .	2
Cauliflower . .	5	Nasturtium . .	5	Spinach . .	5
Celery . . .	7	Onion . .	2-3	Spinach (New Zealand) . .	5
Chervil . .	2	Onion (Welsh) .	2	Strawberry . .	8
Chicory . .	8	Orach . . .	1	Thyme .	2-3
Corn Salad . .	4	Parsley, . .	3	Tomato . .	5
Cress (Garden) .	5	Parsnip . .	1	Turnip . .	5
Cress (Water) .	4	Peas . .	4-5		
Cucumber . .	5				

As a rule, albuminous seeds preserve their vitality longer than exalbuminous kinds. Lindley, in his 'Theory of Horticulture,' p. 79, speaking of the vitality of seeds, says: "Not to speak of the doubtful instances of seeds taken from the Pyramids having germinated, Melons have been known to grow at the age of 40 years, Kidney-Beans at 100, Sensitive Plant at 60, Rye at 40, and there are now (1840) growing in the garden of the Royal Horticultural Society,* Raspberry plants raised from seeds 1600-1700 years old."—(See also 'Introduction to Botany,' 3d ed., p. 35-38.) Seeds should be kept in a dry, airy room or cupboard, and the more equal the temperature is the better. Seeds soon turn mouldy in a damp situation, and the place where they are kept had better be hot than damp. A nest of small drawers is the most convenient place to keep seeds, and the name of each kind should be painted on in alphabetical order. Arranged in this manner they are readily obtainable, and there is less danger of waste, mixing, and confusion, than when kept in papers loosely bundled together in a way which necessitates the whole assortment being looked over when any particular sort is required.

The following excellent practical hints on the management of flower-seeds are from the pen of Mr W. Thompson of Ipswich, who has done much towards fostering and extending the culture of hardy and other ornamental plants in our gar-

* The late Professor Henslow doubted this statement, owing to the probability of fresh seeds having been mixed by accident with the older ones. (See a letter by Dr J. D. Hooker in 'Reminiscences of Fen and Mere' (Longmans), p. 84.)

dens, by importing and supplying seeds of the most beautiful plants of all climates at a just and reasonable rate.

HINTS ON THE MANAGEMENT OF FLOWER-SEEDS.

Hardy Annuals are best sown in the open border in light soil, from March to June for summer and autumn flowering; and in September for flowering the following spring.

Half-hardy Annuals require to be sown in March or April, on a gentle hotbed, or in a close frame *without bottom-heat*, the latter mode succeeding perfectly unless the seeds are sown too early in the season; many of them may even be sown in the open borders at the end of April or beginning of May, but will not then flower so early.

Tender Annuals, a very limited class, will also vegetate in a close frame, but require more warmth to bring them to *perfection* than the preceding; they should, after pricking out, be transferred to a second hotbed, and will flower most satisfactorily in the greenhouse or window.

Hardy Perennials may be sown in the open borders any time from March to August, but will succeed with greater certainty if raised in a close frame, with or without bottom-heat; thus treated, many will flower the first season, if sown early and planted out in the borders in May.

The amateur will do well to bear in mind that though some perennial seeds vegetate as quickly as those of Annuals, there are many others which usually remain dormant for weeks, or even *months*, to this class belong the Gentians, Cyclamens, Pæonies, Fraxinella, many Australian Leguminosæ, and especially North American plants.

Half-hardy Perennials require the treatment of the Half-hardy Annuals, differing only in their need of winter protection.

Stove seeds need a moist, elevated temperature, such as the stove or forcing-pit affords, and greenhouse seeds succeed well under the same conditions, in their absence, the latter are best raised in a good hotbed.

Biennials may be sown in the open ground in spring or summer, not later than June and July, the seedlings being planted in autumn where they are intended to bloom the following season. The half-hardy plants of this class, as Ipomopsis, should be pricked out in pots, that they may be protected in winter.

All seeds sown in frames or pits *require shading* with tiffany or thin calico in bright weather during the middle of the day,

especially as the spring advances. In the open ground, seeds should not be sown too early: there is great risk of failure before the end of March. Where early flowers are desired of Annuals, it is better to sow in autumn.

For all seeds in pots, a compost of *finely*-pulverised leaf-mould, peat, or other vegetable soil, with one-third its bulk of sand or very sandy loam, will answer well: sow very thinly; let the pots be well drained; cover the seed with about its own thickness of soil, and thin out crowded seedlings early. After germination has once commenced, the surface of the soil should on no account be suffered to become dry.

Very small seed, such as Mimulus, Lobelia, Calceolaria, should not be covered with soil, but be sprinkled thinly *on* the soil, which should be *previously* watered from a fine rose. Chinese Primula germinates best when covered with a layer of damp moss; this seed often fails to grow from being too deeply covered with soil, and many other failures are attributable to the same cause.

TRANSMITTING SEEDS, PLANTS, CUTTINGS, OR POLLEN, FROM ABROAD.

"The wild flowers of every clime
Find shelter in our little isle."

THE following excellent practical information on transmitting seeds, plants, or cuttings was originally published in the 'Proceedings of the Edinburgh Botanical Society,' and is so clear and useful that we reproduce it here. The seeds of many tropical plants are very difficult to import in a living state, Nepenthes, Amherstia, and others being familiar examples to propagators. Mr M'Nab says :—

"I have repeatedly tried to get collectors to send home seeds in strong earthen jars or bottles, firmly packed in soil and closely corked, the soil to be taken 6-8 inches below the surface, so as to contain the natural moisture only. As far back as 1834 I introduced in this way acorns of many varieties of American Oaks in excellent condition for growing, while portions of the same lot of seeds brought home in paper and in canvas bags did not succeed. Some Acorns were also brought home between layers of Sphagnum moss, having the superfluous moisture previously wrung out of it. By this method of packing, the acorns all succeeded well. During Dr Little's visit to Edinburgh (from Singapore) in the year 1870, I told him of the disappointments so often experienced with many of his seeds, and recommended him to try the stone-bottle system; and soon afterwards I received a stone jar from him filled with Palm seeds firmly packed in soil, all quite fresh and capable of germination. In districts where Sphagnum moss abounds I would recommend it in preference to soil, as it retains the moisture for a much longer time, and is not liable to mould or decay. In Sphagnum moss the radicles of the seed are often slightly protruding when they reach their destination, while the soil with its natural moisture keeps the seeds in much the same condition as when sent away. Either system is good, and

ought to be more generally adopted, more particularly now, with the facilities afforded by the Post Office for transmission from abroad.

"With pulpy or berried seeds the above methods are by no means satisfactory. I have found from experience that all pulpy seeds succeed best when rubbed out in dry white sand. After being spread out in the sun or wind for a day or two to dry, the mass should be collected and packed firmly in stone jars; and when they reach their destination, the contents of the jars should be taken out and covered with soil according to the size of the seeds. By this method I have frequently sent to Australia, Canada, and other distant parts of the world, the seeds of Strawberries, Gooseberries, Raspberries, Brambles, Currants, Blackberries, Laurels, Elderberries, Thorns, Hollies, Yews, &c. Any portion of the pulp remaining with the seeds seems less liable to decay when mixed with dry white sand than with soil or Sphagnum.

"For a long series of years it has been customary to send home seeds packed in charcoal, and I regret to see it still recommended. Such a practice, however, ought to be entirely abolished, as it tends to destroy the vitality of the seed. Unless in the case of seeds with very fleshy cotyledons, few others packed in this way ever grow. It is not necessary that seeds should always be sent home in comparatively dry soil in earthenware bottles. About eighteen years ago I had some seeds of the Akee fruit (*Blighia sapida*) sent from the West Indies. The seeds had been put into a large old blacking-bottle (after being thoroughly cleaned inside), in a mixture of soil and water, firmly closed with a clean bung cork and thickly sealed over. When they reached me, I broke the bottle, and found every seed in a growing state. Each seed was put in a pot and set in a dark place for a time, light being admitted gradually; they soon lost their pale hue, and are now fine thriving trees. This simple method is also worthy of imitation with many hard tropical seeds.

"Wide-mouthed glass bottles are also extremely useful to botanical collectors and amateur horticultural travellers. During my annual autumnal peregrinations, both in this country and abroad, I have kept cuttings of rare stove and greenhouse plants in clean old pickle-bottles in excellent preservation for a fortnight, with a little moss and water, and have always found them to succeed well after reaching home, if placed in an ordinary propagating pit or frame, in a pot of fine sand covered with a bell-glass. During a visit to the Forest of Fontainebleau, I picked up a number of two-years-old seedling Oaks, Elms,

and other trees, and put them all in a glass bottle, among clean moss and water. After ten days' confinement I broke the bottle, put the young trees into pots, and placed them for a time in a shady situation; they are now fine healthy trees. I mention this circumstance for the information of parties wishing to bring home from some remote, celebrated, or interesting spot a memorial of their visit, as was the case with myself. Such seedlings will succeed equally well if lifted any time during the spring, summer, or autumn months. The chief risk is the sudden exposure to air and light. Alpine plants are easily conveyed from their native habitats by the glass-bottle system; a strong, wide-mouthed bottle will hold a large number of such plants, if put up in the way described. By this method they will reach home in a much better condition for growing than they do when rolled in brown paper."

Rare succulent plants, epiphytal Orchids, bulbs, or tubers, may now be sent from India and other countries with facility and despatch by parcel-post at a cheap rate (about one shilling per lb.); and travellers or tourists might adopt this method of sending small Alpine plants, bulbs, and seeds from southern Europe with advantage In sending plants by post, they should be packed in Sphagnum moss wrung nearly dry, as above recommended, and then wrapped in thin sheet india rubber or oiled silk, the whole being encased in a few folds of coarse brown paper. Of course the methods above recommended are equally serviceable in exporting small parcels of seeds, cuttings, bulbs, or plants. Cuttings packed in living Sphagnum moss, and enveloped in tinfoil, travel in excellent condition

A British correspondent of the 'English Mechanic' remarks that the primitive Hindoo was the first discoverer of the proper packing of tender cuttings, and to his intuitive simplicity he was heavily indebted for a large portion of the floral treasures he collected and had the pleasure of transmitting during his long sojourn in the East and other quarters. The following is a description of the process: Having tied your various cuttings up in lots, and all of as nearly the same length as possible, proceed to cut down that very ubiquitous tree, a Banana. Say your cuttings are 18 inches long, you will require a case of 2 feet; you therefore chop off a thick portion of the above length, and next, with your axe, split it lengthways and remove the fleshy bark, set like the coats of an Onion, layer upon layer. Within this case you pack your cuttings rather loosely, in slightly moist moss to prevent their heating, securing the two halves of the Banana stems with ties of bark or twine; then you make a stopper for each end of the same substance,

and dipping them first in moist clay, drive them in, and cut them off quite even with your box. The package should then be sewn up in stout waxcloth, bearing the direction, destination, &c.

In some cases a thick piece of green Bamboo is preferable to the Banana as a case for cuttings, and the following methods or modifications of the process just described will be useful in particular cases :—

1. The bundle of cuttings, being packed air-tight and water-tight in sheet india-rubber, is immersed in a ship's water-tank.

2. Packed similarly, they are stowed in a ship's ice-room.

3. Enwrapped in several folds of waxcloth, and then dipped several times in a liquefied mixture of soap and wax till densely covered; these many coats can be afterwards pressed with the hand into a dense mass.

The beautiful *Lilium giganteum* of the Himalayas was long in being introduced into Europe; the bulbs invariably failed, until Dr Royle hit upon the soap-and-wax process. Collodion for healing the points or ends of cuttings is also a modern practice to prevent "bleeding" and exclude air. There is a valuable substance in use throughout the north-western Himalayas for roofing dwellings and granaries—*i.e.*, Birch bark: this tough pliable product I found far superior to any kind of paper or cloth as a wrapper. The plant-collector spreads a quantity of fresh damp moss on one of these sheets, and rolls the whole up tightly, using ties to secure the parcel.

The best and most expeditious method of sending pollen for hybridising purposes here in our gardens at home is to shake it carefully from the anthers and expose it to the sun in a sheltered position, this being necessary to prevent its turning mouldy or damp during its journey. It should then be wrapped first in soft paper and next enclosed in tinfoil, after which it can be put in a letter and mailed in the ordinary way. It is necessary in transmitting pollen to state the name of the plant from which it was taken, otherwise it is next to useless. By advertising in the horticultural journals it is quite possible to obtain pollen of any desired plant either from Continental gardens or other places abroad; and this power, if judiciously taken advantage of by hybridisers, would enable them to obtain fertile seeds of many new or rare plants, and especially of such diœcious plants as some rare Conifers, Palms, and other exotics.

ARTIFICIAL METHODS BY WHICH PLANTS ARE MULTIPLIED.

Artificial or vegetative means of propagation are resorted to by cultivators in order to reproduce and multiply existing cultivated forms of useful or ornamental vegetation in the shortest possible time; while in the case of cross-breeding or hybridising, provision is made for the possible origination of new forms or varieties, instead of merely reproducing the parent plants. There are many cases in which seed will not exactly reproduce the parent plant, even when means are adopted to prevent cross-fertilisation; and then recourse must be had either to cuttings, layers, or division, by which a portion of the required individual is secured, and means are used to induce it to throw out roots and establish itself, as in the case of cuttings. Grafts are cuttings neatly joined to a suitable stock, by which they receive the benefit of roots already formed and in working order; but it is now known that grafts are frequently changed if worked on another variety as a stock, and therefore cannot be said to exactly reproduce the parent plant, as is the case when propagation is effected by cuttings, layers, or by dividing the original in any other way. We shall, however, glance at the different artificial methods of plant-propagation in their due order.

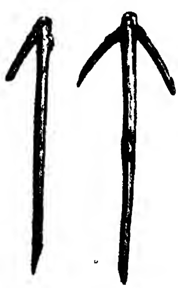
PROPAGATION BY DIVISION.

Division is the easiest and most generally adopted method by which low-growing or spreading Alpine and herbaceous plants are reproduced. Bulbs—as Snowdrops, Narcissus, and other gregarious kinds—are also multiplied in the same way, each separate bulb being a distinct individual plant. Although the word multiplied is used here, it is scarcely applicable, since no artificial multiplication of plants has really taken place. The same number of plants existed in the clump before they were divided; only, by so dividing them, they afterwards, when planted in fresh soil, develop themselves much more rapidly

than if left in one dense cluster. Nearly all plants which form low-spreading clumps or masses of root-stocks may be divided either by digging up the plants and pulling them into rooted pieces, or by cutting off rooted portions around the sides of the clumps. The scaly bulbs of many Lilies may be pulled to pieces and planted separately, and most of them, when so treated, will grow and form plants; but the bulbs of Lilies are in reality only underground stems, so that the Lily scales are really leaf slips or cuttings—just as Potato "sets" are stem-cuttings—although at first sight one would imagine that they came under the head of division, using that term in its popular and technical sense. Division, then, may be defined as the removal of any *naturally* rooted portion from any kind of plant, and is especially practicable in the case of low-growing and spreading kinds.

PROPAGATION BY LAYERS.

This simple method of propagation is principally adopted in the case of low-growing or slender plants which cannot readily or conveniently be multiplied either by division, cuttings, or seed. *Lapageria rosea*, *L. alba*, *Chimonanthus fragrans*, *Aristolochia sipho*, and *Magnolia grandiflora*, are a few among



Pegs for Layering.

Layers.

many instances in which layering is adopted as the best or readiest method of artificial reproduction. The operation is one of the simplest: A branch or stem of the plant or tree is bent down, and pegged or otherwise fastened or held below the soil, with its growing extremity above the ground. In some cases, as in the Carnation, the stem is nicked or slit at a joint

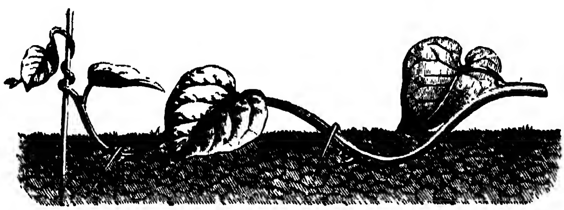
with a sharp knife, which causes the juices of the plant to exude and form a spongy mass of cellular matter ("callus"), as is the case in cuttings. This callus is a sure sign of the appearance of roots. This is the common and most simple plan of layering, but not always practicable. The mountain will not go to Mohammed, and then Mohammed must go to the mountain. This is so in the case of erect growing or tall-growing plants, and then a modification of layering is resorted to, exactly the same in its effects, but a little different in practice. In the case of Dracænas, which frequently become what is technically termed "leggy"—that is, devoid of foliage below—it is advisable to lower them; and a pot, or the two halves of a pot, with the drainage-hole enlarged, is placed around the stem just

Simple Layering (Privet)

below the leaves, and the bark is slit with a knife so as to cause a callus to form. The pot is then filled up with soil, and is kept continually moist. Sometimes this plan is slightly modified, a bunch of wet moss being substituted for the pot of earth. This plan may be modified or utilised in a hundred different ways by the intelligent cultivator, and is especially applicable in the case of indoor or tropical plants and Vines, where the part required to root ("strike") is too large or otherwise inconvenient as a cutting. Ringing a desirable or suitable branch, and the application of moist clay or earth, which is kept in its position by split Bamboo or by cloth bandages, seems to be a common method of propagation by nearly all Eastern nations; and the Chinese and Japanese use this plan

as a starting-point in the formation of the Dwarf Plums, Oranges, Almonds, Peaches, Gardenias, Elms, and other miniature trees, of which they are so fond. The remaining part of the process consists of starving in small shallow pots and poor soil, and pruning the roots and branches so as to stunt them both in an equal degree.

There is a common mode of propagating adopted in nurseries technically termed "hillock layering"—a plan as successful as it is simple. This is used in propagating the Quince, Plum, Apple—more especially Paradise, Doucin, and Nonsuch for stocks—Fig, Hazel, Magnolias, and many other hardy trees and shrubs. In this case it is necessary that the plant operated on be on its own roots. The tree or shrub is cut down nearly level with the ground during the winter. This causes a cluster of latent buds near the surface of the ground to develop themselves and form young shoots; and when this



Multiple Layering (Aristolochia).

happens, a hillock of soil is raised so as to cover the base of each shoot, and the tops are pinched off, to induce them to throw out rootlets at the base. This they generally do during the summer; and in the autumn the soil is cleared away and the young rooted growths removed, and either potted or transplanted, as may be convenient. Such of the shoots as have not formed roots are left until the following spring or autumn; and these old stocks or stumps thus go on producing young plants for several years in succession. Some climbing or trailing plants—as double-flowered Rubus, Wisteria, Aristolochia, Lapageria, Vine, Fig, and others—are propagated by "multiple layering," one, or more of the last year's young shoots being laid in a trench and covered with soil, except at the growing end, which is left outside to grow and keep the branch so buried in an active state. Sometimes the branches so treated are bent or partly fractured at intervals between the joints, or cross incisions or slits are made under the eyes with a sharp knife, so as to induce the "callussing"

process and the development of its attendant rootlets. Long shoots or branches so treated produce several individuals, according to the number of nodes or joints, and when rooted are separated and treated as separate plants, or for stocks if requisite.

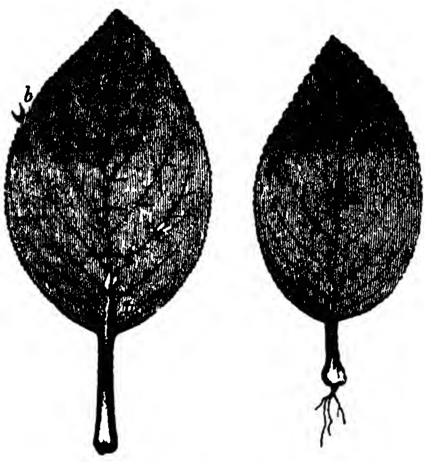
PROPAGATION BY CUTTINGS.*

This is a very popular and in general expeditious mode of propagation, and, like division and layering, exactly reproduces the parent plant from which the cuttings are taken; hence these modes of propagation are often preferable to either grafting or seed, especially soft-wooded subjects, and cuttings develop themselves much quicker as a rule than either grafted or seedling plants. Nearly all "soft-wooded" plants—of which Fuchsias, Lobelias, and Pelargoniums are examples—are best propagated from cuttings of the stem. Many thick-leaved Begonias, Gloxinias, and Melastomaceous plants are readily multiplied by leaf-cuttings, the fully-developed leaf being inserted in a cutting-pot as a cutting. Some Begonias—as *B. Rex*, *B. grandis*, and the newer kinds—and strong-growing Melastomads, are readily propagated in this manner if the leaves are divided into pieces an inch or so square. Hoyas, Fuchsias, Gesneras, and even bulbous plants (as Amaryllis) may be reproduced in this way. In cases where cuttings cannot be obtained from the leafy portions of the plant—as in *Drosera* (*binata*) *dichotoma*, *Dionæa muscipula*, Sarracenias, and Darlingtonia—cuttings may be made by dividing the underground stems, or rhizomes, and planting the cuttings so obtained in pans placed close under the glass of the propagating pit. Cuttings of the root succeed in a vast number of plants; and it is often necessary that the cultivator should avail himself of every portion of the plant, at a time when speed in reproduction is synonymous with commercial success. It is only in rare instances that new or rare plants can be kept for years in the propagating pit, since time is money; for if one firm does not supply a new plant quickly, the chances are another will, so keen is modern competition in trade. Cuttings of the bulb are often resorted to, especially in the case of new Hyacinths and other bulbous flowers, the cut portions of which emit little bulbils, which are afterwards grown on up to

* M. Neuman, who was formerly superintendent of the plant-houses in the Jardin des Plantes, Paris, published a most interesting little work entitled 'Notions sur l'Art de faire de Boutures,' and an illustrated translation of this was subsequently published in the 'Gardeners' Chronicle,' 1845, vol. iv. pp. 116, 132, 149, 185, 208, 225, 240, 272, 384, 472, &c.

the flowering stage. Nearly the whole of the bulb trade, however, is carried on by the Dutch florists, if we except our Lincolnshire Snowdrop growers. Many succulent plants—as Kleinias, Pachyphytums, Bryophyllums, Rocheas, and Echeverias—may be readily propagated from the leaves inserted in pots of sandy compost. Of course, much of the above will necessarily be repeated in the alphabetical list of plants to follow; but I have written this much here to show how variable cuttings may be—root, underground stems, above-ground stems, bulbs, tubers, corms, leaves, or even portions of leaves, according to the plant operated upon. Some plants, however, are very difficult to propagate from cuttings—one of these being the fragrant Chimonanthus; indeed the late Dr Lindley

Stem Cutting of Pelargonium.



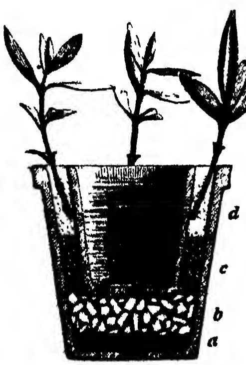
Leaf-Cuttings of Gloxinia.

once offered a guinea for every plant of this well-known shrub raised from cuttings. Lapagerias, Aristolochias, Ipomœa Horsfalliæ, are other examples. Mr F. Bause, when propagator at Chiswick some years ago, did succeed in inducing cuttings of the Chimonanthus to produce roots; but the tops never pushed away, and they eventually died. A correspondent of the 'Garden' of Feb. 14, 1874, however, writes that she raised two plants from cuttings. "They were taken during the summer when the leaves had arrived at full growth, planted in light soil in pots, and placed in the shade in a vinery. They were kept in a cool greenhouse all the winter, and next spring

they pushed forth fresh leaves. One I gave away; the other I planted against a south wall, and it is now 3 feet high and in bloom."

A cutting may be defined as any portion of a plant, root, stem, bud, or leaf which is separated from the parent and induced to form roots of its own. "Eyes" are cuttings consisting of one bud only, just as "buds" are in reality single-budded scions or grafts. There is considerable resemblance and analogy between a bud or "eye" and bulbs and seeds, and all may alike be utilised for reproductive purposes by being placed in suitable conditions of heat and moisture; and the same cellular tissue or callus which precedes the formation of roots, and which is indeed part of the root-producing growth of the eye or cutting, when planted in soil, also insures the junction of the graft or scion and the transplanted "eye" or bud in the operation of grafting and budding. "The importance of buds in the propagation of plants, although well known to botanists, has hitherto been comparatively little attended to by propagators in general. Their universality is much greater than is usually thought; for, as has been stated by Professor Balfour, in 'Class Book of Botany,' the higher classes of plants may be considered as consisting of numerous buds united on a common axis. These possess a certain amount of independent vitality, and they may be separated from the parent stem in such a way as to give origin to new individuals. In some instances buds are produced, which are detached spontaneously at a certain period of a plant's life, as instanced in stem buds of *Lilium bulbiferum*, *L. tigrinum*, *Ixia bulbifera*, &c. 'The cloves formed in the axils of the scales of bulbs are gemmæ, or buds which can be detached so as to form new plants. Such is also the case with the corms of Colchicum. In these instances buds are developed in the usual way in the axils of leaves or scales—that is to say, at the points where they join the stem.' Besides the true or visible buds, there are embryo buds contained in the bark or the wood of many, nay, probably of most trees. Of these are the excrescences called *uovoli*, found on old olive-trees, and, according to Signor Manetti, used by the Italian gardeners for propagating that tree. These are supposed by Professor Lindley to have been 'adventitious buds developed in the bark, and by the pressure of the surrounding parts forced into those tortuous woody masses in the shape of which we find them.' It does not appear that advantage has hitherto been taken in this country of these as a means of increasing the trees on which they are found, although there is little doubt they might be

employed in cases of emergency." * These single-budded cuttings or "eyes" are generally employed in propagating the Grape-Vine, and more rarely in the case of Roses and Poinsettias. A cutting may vary in size, but is in general from 1 to 4 inches in length, and consists of a young shoot taken off the plant with a sharp knife, after which it is cut off horizontally below a joint and inserted in the earth if hardy, or in a pot of sandy soil if tender. Sometimes the lower leaves require cutting away to enable the cutting to be inserted in the soil. Soft-wooded plants, such as Lobelias, Fuchsias, and many others, will strike root freely if severed between the joints—anywhere, in fact; while Geraniums will frequently rot off unless trimmed below a joint: and this is the case with many other plants, especially if their growth is succulent; hence, as a rule, it is always best to cut or trim cuttings below a joint. Some plants propagate better from "slips" than cuttings—"slips" being short side-shoots or lateral branches slipped or pulled off so as to bring with them a heel of the old wood. As a rule, cuttings "strike" better in the spring and early summer than in the autumn and winter, the plants being then more vigorous than is the case later in the season. This is an important fact for amateurs; but practical propagators, with every appliance in the way of heat and moisture, can afford to ignore nature's way of working in this matter. Many soft-wooded plants, or those of succulent habit—as Pelargoniums, Helichrysums of the *H. bracteatum* type, and others of similar character—are rather difficult to propagate from cuttings late in the autumn, especially in wet seasons; and in such cases cuttings taken from pot-plants which have suffered for want of water during the hot weather will be found not only to strike root more easily, but they will not damp off so readily during the winter, owing to their tissues being firmer in texture. It is a well-known fact that many cuttings root more freely if they touch the sides of the pot or pan in which they are planted. Our engraving shows a method invented by Mr Forsyth, and fully described in the 'Book of the Garden,' by which this end is secured and provision made for a gradual supply of moisture at the same time. The inner



Striking Cuttings.

* Book of the Garden.

pot (*e*) is filled with water, the drainage hole being plugged with clay, and it is then elevated on the drainage (*a*, *b*); the space (*c*) between the two pots is then filled up with soil, over which is a layer of sand (*d*), into which the cuttings are inserted, their bases touching the inner pot as shown. No watering is required, as the water in the inner pot keeps the soil constantly moist.

Tabular View of the Parts of Plants from which Cuttings may be taken.

Some plants are best and most quickly propagated by stem-cuttings; others, as Begonias, Melastomads, &c., by leaf-cuttings; and others again, as Drosera, Dionæa, Cephalotus, Sarracenia, &c., by root-cuttings. There are but few plants which may not be propagated from cuttings in one or more of the ways enumerated below.

Leaf	Stem	Root.
Whole leaves fully developed, as in Gesnera, Gloxinia, Hoya, Bryophyllum &c	Old or ripened wood	Woody roots cut into pieces, as Manetti Roses, Common Roses, or Wild Brier for stocks, Clematis, and Aralia
Old leaves pegged down on a pan of soil, their ribs beneath having been previously slit across, as in Begonias and Melastomads	Partly hardened wood of current year's growth, with a heel of old wood at the base	Fleshy or partly hardened roots cut into lengths, as in Seakale, Iris Horse radish, Drosera, Sarracenia, Dionæa, &c
Old leaves cut into pieces, with a portion of a thick rib or vein to each	Young growth or current year's wood in autumn, when thoroughly ripened, as in Currants, Gooseberries, &c	Annulated roots or jointed rhizomes as in Ipecacuanha, &c (It should always be borne in mind that rhizomes are true stems, although often underground, and, like the pseudo-bulbs of orchidaceous plants, they are always furnished with true latent buds, which start into growth under favourable conditions True roots, on the other hand, are not furnished with buds, as a rule, in any regular manner, although the roots of many plants have the power of forming irregular or adventitious buds when severed from the parent plant and subjected to genial conditions of heat and moisture I allude to rhizomes under this head because they are popularly regarded as roots.)
Basal or lower half of leaf and leaf stalk	Young growth partly hardened at the base, but not thoroughly ripened	Knaurs on roots often form buds adventitiously much quicker than the ordinary roots, as in Yucca.
Whole leaf or basal half of leaf, with portion of the stem or bark and an axillary bud or eye, as in Rose, Pelargonium, &c	Young and soft growth or herbaceous cuttings made in the open air, as in most rare hardy trees and shrubs	Thick fibrous roots, as in *Platycerium stemmaria* and *P. biforme*.
(Leaves fully developed, and even the fleshy bracts of many succulent plants, strike root readily This is especially the case with Pachyphytums, Echeverias, Sempervivums, Gasterias, many Haworthias, and other plants of similar nature.)	Herbaceous cuttings made in heat, as in Erica, Epacris, and rare hardy trees and shrubs.	
	Tubers cut to eyes, as in Dahlia, Potato, or Hollyhock, Marvel of Peru, &c.	
	Eyes off ripened wood, as in the case of the Grape-Vine, and Poinsettia, Dracæna, &c.	
	Eyes taken off young shoots, as in new Zonal Pelargoniums, Roses, &c.	
	Knaurs, or irregular masses of buds and cellular growth on stems, may often be used for purposes of propagation with advantage.	

The great secret in propagating nearly all plants from cuttings is to prevent them "flagging" or drooping from evaporation or loss of moisture after they are separated from the parent plant. It is to prevent this happening that propagators invariably use close cases in the propagation of all the more tender stove and greenhouse plants. In the case of a single pot or two of cuttings, they are simply covered with a bell-glass, which serves exactly the same purpose in checking evaporation. All the dew-like moisture you see on the lights or glass covering of the case, or trickling down the sides of the bell-glass, would have passed off into the drier atmosphere had the cuttings been uncovered; and this drying influence is prejudicial to the welfare of the cutting until it has formed roots, which, by drawing or pumping up moisture into the leaves, replace the loss occasioned by transpiration. Succulent plants, such as Echeverias, Pachyphytums, Phyllocactus, Sempervivum, Gasterias, and many others, however, do not require covering, as Nature herself has formed them for living in a dry atmosphere, and has given them a thick-celled skin, through which the water in their leaves can pass but very slowly; and to cover these up in the manner above described as fitted to the generality of tender ornamental plants, would induce nine-tenths of them to rot or "damp off" instead of forming roots. Some cuttings are very difficult to root, owing to their tendency to damp off; and when this is the case, Col. Trevor Clarke, F.R.H.S., recommends that the bases of the cuttings should be dipped in a strong solution of collodion two or three times, allowing the film to form each time, after which plant them at once in a rather dry medium. Thomson's "styptic" has also been recommended in the case of cuttings which are apt to bleed profusely when cut from the plant, as Stephanotis, Euphorbias, &c. Plants with soft velvety or woolly leaves, as Gnaphaliums, Centaureas of the *C. candidissima* (*C. Ragusina*) type, and other plants with similar foliage, often refuse to root unless fully exposed to the sun and air, either in a sunny frame or on a shelf in the greenhouse near the glass. Cuttings or slips of many hardy Alpine and herbaceous plants or florists' flowers, as Chrysanthemums, Pansies, Phlox, and others of a similar character, may be inserted in pans of moist, sandy soil, and placed in a cold pit; or an ordinary garden frame placed under a north wall is well suited for this class of subjects. Many hardy shrubs and bush fruit-trees, as Laurels, Currants, Gooseberries, &c., root freely if they are taken off in the autumn and inserted in rows on any cool sheltered border having a northern aspect. Tamarisk, Willows, and large branches three or four feet in length of some

sorts of Apples of the Bur-Knot type, strike readily in this manner. Mr. T. A. Knight succeeded in propagating Apples, Pears, Plums, and Cherries by root-cuttings, about a foot in length, and not less than a quarter of an inch in diameter, planted in November, leaving about an inch above the surface.—(See Trans. Hort. Soc., 1816, vol. ii. p. 252.)

Many hard-wooded cuttings refuse to root if placed in bottom-heat at once after being cut, especially if they have been brought in from the open air; but if they are set in a cold frame or pit until they "callus," and are then brought into heat, they produce roots freely, and start into growth at once.

On the advantage of bottom-heat applied at the proper time, Dr Lindley remarks, in 'Theory of Horticulture,' p. 213: "This is for the purpose of giving them a stimulus at exactly that time when they are most ready to receive it. Had they been forced at first in bottom-heat, the stimulus would have been applied to cuttings whose excitability had not been renovated, and the consequence would have been a development of the powers of growth so languid that they probably would not have survived the coming winter; but the stimulus being withheld till the cuttings are quite ready for growth, it tells with the utmost possible effect." Soft-wooded cuttings, as Alternantheras, Verbenas, Lobelias, &c., may be rooted very quickly and easily by placing zinc pans, about a foot wide and one and a half inch in depth, on the hot-water pipes. These pans should be filled with sand saturated with water; and in this medium, aided by the bottom-heat thus secured from the pipes, a large number of cuttings may be rooted in a very short time.

Any light, sandy, moist soil may be used in which to insert soft-wooded cuttings. If, however, they are tender, or there is any danger of their damping off—as is the case with Ericas, Epacris, Azaleas, and many succulent plants—a thin layer of clean white sand should be spread over the surface of the compost in the cutting pots or pans; and the pots may in such cases be three parts filled with crocks, so as to insure perfect drainage. Cuttings of many plants strike or root freely in any soft, moist substance: for example, soft-wooded plants of free growth, such as Fuchsias, Verbenas, and Lobelias, root quickly and freely in saucers of wet sand, or sand and water, if placed in an exhilarating temperature. Rose-cuttings, as well as those of the Oleander and many other plants, root freely in bottles of soft or rain water; and cuttings of Nepenthes root well in living Sphagnum moss in a close heated frame. In the humid

Amherstia-house at Chatsworth these plants are grown to great perfection, and I have seen dozens of cuttings taken off and inserted in the Derbyshire spar used for covering the side benches; and treated in this manner, some of the cuttings formed great masses of black fibrous roots as large as a child's head.* Common sawdust from the wood of ordinary forest-trees (not Conifers) forms a good rooting medium for many soft-wooded plants, which damp off if placed in soil or sand. Cucumbers, Melons, Ficus, Fuchsias, Gesneras, Tydeas, and many other plants, root well in a bed of sawdust and sandstone. Grit or gravel, coke-dust, or sand, are also useful in the case of succulents which are apt to damp off in ordinary soil. As a rule, however, it is best to strike cuttings in soil similar to that which suits the plant when developed; for if rooted in water, or other soft, moist substance, extra attention and care are required when such cuttings are potted, as their roots, being much more tender than when produced in soil, are apt to become bruised or broken; and even if they escape this through careful treatment, they are still liable to perish or damp off when placed in a colder and denser compost. The herbaceous flower-stems of some plants, such as Hollyhocks, tall Phloxes, and the double-flowered scarlet Lychnis, may be cut into lengths and treated as recommended for herbaceous cuttings.

Cuttings of the stem, as in *Cycas revoluta* and other species, throw out offsets freely; or the old scales, if taken off carefully and placed in a heated case, throw out young plants, by the development of adventitious buds, in much the same manner as do the scales of Lily, Fritillaria, and other large bulbs.

Most endogenous stems, as Arundo, Maize, Bamboo and Sugar-Cane, Dracæna, &c., may be propagated from by cutting them into lengths (for the sake of conveniently getting them into the propagating cases), and laying them on moist soil or soil and moss, in a gentle bottom-heat of 65° to 75°. So treated, they, on being excited by the heat and moisture, throw out numerous offsets at the nodes, and these may be taken off and carefully potted when sufficiently developed. Arundo stems produce these offsets freely if they are cut and thrown into an open-air tank.

* It is curious what a small proportion of coniferous sawdust makes this medium worse than useless. This is doubtless owing to the resin which exudes copiously in a warm atmosphere, so much so as to exclude the air, the result being a state of stagnant dampness which causes the cuttings to rot off.

TABULAR VIEW OF THE SOILS AND OTHER MEDIUMS IN WHICH CUTTINGS MAY BE ROOTED OR SEEDS SOWN.

(Both physiology and practice have decided that dormant eye or bud cuttings of the thoroughly ripened wood, as in the Grape-Vine or Poinsettia—and cuttings of the root, as in Cephaelis, Bouvardia, Aralia, Solanum, Drosera, &c.—are best treated precisely like seeds, so far as covering with soil, heat, partial darkness, and moisture are concerned; indeed, theoretically speaking, seeds are marginal leaf-buds.)

Heavy,	Loam, or loam and sand,	Hardy trees and shrubs
Moderately heavy,	Loam, peat, and sand,	Greenhouse plants.
Dry and light,	Peat and sand,	Ericas, Epacris, &c.
Light and rich,	Leaf mould and sand,	Stove foliage-plants, &c
Dry,	Sand or sandstone grit, brick-dust, burnt clay, or gravel,	Succulents and woolly composites.
Light and moist,	Sawdust or sawdust and sand or cocoa-nut fibre,	Soft wooded plants, as Cucumbers, Melons, Tomatoes, &c
Moist,	Sand and water,	Lobelias, Begonias, &c
Moist and airy,	Living Sphagnum moss,	Cuttings of Nepenthes, Gardenias, Dracænas, Orchids, &c , Orchid and Nepenthes seeds &c
Moist air,	This medium is easily obtained by inverting thumb pots on a bed of moist moss or sawdust after which insert the cuttings through the drainage hole, but not so far as to touch the bed below	Nepenthes, Gardenias, Tree Pæonies and cuttings of Gesneriaceous plants.
Wet,	Soft water in tubes, bottles, or phials, with a little charcoal added to preserve it clean and sweet,	Nerium, Roses, Begonias Fuchsias, and many stove plants

Herbaceous Cuttings.—There are but few hard-wooded plants in cultivation, whether hardy or tender, that cannot be propagated by herbaceous cuttings—that is, cuttings of the young wood taken off just as the base of the shoot begins to harden and the lower leaves are fully formed. Cuttings of this description should be cut quickly, and at once inserted into cutting pots or pans, or pricked into a bed of light sandy earth in a close pit or frame where a humid atmosphere can be maintained, to prevent flagging through superfluous evaporation. In the case of tender shrubs, a gentle bottom-heat of 60° to 70° is an additional incentive towards root-formation, as genial heat and humidity quicken the action of the leaves and cause the more rapid formation of the loose cellular tissue at the base of the shoot (technically called "callussing"), from which the young roots proceed. Hollies, Conifers, and most other hardy shrubs and trees from which seeds are not readily obtainable,

may be propagated readily in quantity by taking off herbaceous cuttings in July, or even earlier, and inserting them in cutting-pans in a close frame, taking care to syringe them lightly once or twice every day; or they may be struck in a heated propagating case, and afterwards carefully hardened off. Continental propagators strike nearly all plants, hardy as well as tender, under *cloches* or bell-glasses, in a close, humid plant-house or propagating pit, and in this way are enabled to turn out an immense stock of fresh little plants in an incredibly short time compared with our system of striking cuttings in autumn under a north wall. Nor is this all: for sometimes it is necessary to grow the plant from which cuttings are to be taken in heat, in order to insure success, taking care to keep the roots nearly dry; for many trees and shrubs make a watery or succulent growth out of doors, which is not suitable for cuttings, as they damp off instead of rooting, while young growths made in heat may actually be struck in the dampest of all mediums—soft water, in bottles suspended near the light, but shaded from bright sunshine. The propagator who would be successful must never lose sight of the great fact that the actual rooting power—or uniting power, in the case of grafting—lies in the growing or cellular tissue. Soft-wooded cuttings, such as Pelargoniums, Fuchsias, Lobelias, Begonias, Calceolarias, and other plants of a similar character, are readily struck even by village dames, who merely stick slips or small lateral branches around the sides of the flower-pots in the open window, and rarely without success. It is curious to observe that, while many gardeners strike Ericas, Epacris, and Azaleas readily from cuttings, they rarely if ever think of attempting to propagate new or rare Conifers, or hardy evergreen or deciduous shrubs, in the same way. Indeed, to many amateurs the propagation of Conifers and hardy shrubs is apparently a sealed book. How often do we see, in looking over a great garden, Dracænas, Ericas, Crotons, Gardenias, and other exotics, propagated by the hundred! but how rarely are we shown a batch of young Hollies, Abies, Piceas, or a pan filled with rooted cuttings of some rare and beautiful hardy Conifer or ornamental shrub!—and yet the one is just as easy to propagate from cuttings as the other.

PROPAGATION BY GRAFTING AND BUDDING.

"You see, sweet maid, we marry
A gentle scion to the wildest stock,
And make conceive a bark of baser kind
By bud of nobler race, this is an art
Which does mend nature; change it rather, but
The art itself is nature."

—SHAKESPEARE

"For a long time gardeners, as a rule, refused to believe in the reciprocal action of stock and scion but the evidence is becoming too overpowering to allow the matter to remain doubtful — M T MASTERS, F R S

GRAFTING* is an ancient and well-known art, which consists in removing a portion of one plant—the part so removed being technically called the graft or scion—and applying it to another rooted plant called the stock, in such a manner that they become united, and fulfil their allotted functions, the scion producing fruit or flowers, while the business of the stock is to supply the requisite quantity of root nutriment from the earth. In point of fact the graft is a cutting which is induced to unite some of its tissues with those of the stock, instead of forming a callus and emitting rootlets, as happens when the cutting is inserted in the earth. It is interesting to note, that while most exogenous plants may be reproduced from grafts, it is nearly impossible to graft a single species of endogenous plant whatever, if we exempt some Aroids. Success in grafting demands not only considerable dexterity on the part of the operator, but it is highly essential that there be an affinity between the stock and the graft. Of the nature or cause of this affinity, or consanguinity, we know as yet but little; and botanists—that is to say, the mere classifiers, who work by the results of certain laws in nature, without consider-

* For a valuable and interesting paper on grafting, its consequences and effects, see Gard. Chron., 1872, pp. 215, 322, and 360: see also an intelligent paper on this subject by A. Murray, Esq., F.L.S., in Jour. Royal Hort. Soc., 1873, vol. iii. p. 116; or 'Garden,' 1873, vol. iii. p. 72; and also 'Gardeners' Chronicle,' 1871, pp. 584, 585.

ing the laws themselves—give us very little aid in determining what the cause and nature of this affinity really is. In M. Baltet's 'Art of Grafting' (a first-rate and very exhaustive work, by the way, which every cultivator should read), the following remarks on this subject are made: "The laws of the affinity of species are almost unknown. The observations hitherto made have been undertaken in a practical rather than in a purely scientific spirit, as in the fertilising of plants. The results obtained up to the present can only be regarded as a matter of fact. No theory has as yet been deduced from them except that kinds to be united must be of the same botanic family. For instance, the Peach and the Apricot are grafted on each other with difficulty, while both do well on the Almond-tree and the Plum-tree.' All the Cherries unite with the Mahaleb, but it will not succeed as a graft on any of the Cherries. The Sweet-Chestnut prospers on the Oak, but will not do so if grafted on the Horse-Chestnut, which belongs to another family. The Medlar and the Quince, which have solitary flowers, flourish on the Hawthorn, whose flowers are in corymbs. The Chionanthus, so nearly allied to the Lilac by its panicled flowers and simple leaves, only succeeds well on the common Ash and on the flowering Ash, which have compound leaves. On the other hand the Sorbus, with pinnate leaves, is more vigorous when grafted on the Thorn (whose leaves are more entire) than it is when grown on its own roots. The grafting of evergreen trees on deciduous kinds presents more than one singularity. The Photinia, allied to the Beam-tree, and the Eriobotrya (Loquat), allied to the Medlar, are grafted on the Medlar and not on the Hawthorn. On the last, as a stock, the Cotoneaster and the Pyracantha do well. The Mahonia flourishes on the Berberis, and the common Laurel succeeds on the Bird Cherry, and even on the Wild Cherry, from which it differs so much in appearance." But while some evergreens succeed well on a deciduous stock, "the grafting of deciduous plants on those that are evergreen has in almost every case been attempted in vain. Those who are fond of oddities can, with the assistance of grafting, have on the same Thorn stock at the same time fruiting-branches of the Pear, the Medlar, the Beam-tree, the Service-tree, the Mountain-Ash, the European and Japanese Quince, and also see there the flowers of the Double and Red Thorns, the Cotoneaster, and the Pyracantha. They may gather from the same Plum stock, Plums, Apricots, Peaches, Nectarines, Almonds, the corymbs of the Canadian Cherry, and flower garlands of the Chinese and Japanese Plum; but these whimsicalities are

unworthy the attention of cultivators." A correspondent of the 'Cultivator' remarks: "We can graft the Apricot on the Plum, and the Peach on the Apricot, and the Almond on the Peach, thus producing a tree with Plum roots and Almond leaves. The wood of the stem will consist of four distinct varieties, though formed from one continuous layer. Below the Almond wood and bark we shall have perfect Peach wood and bark, then perfect Apricot wood and bark, and at the bottom perfect Plum wood and bark. In this curious instance we see the intimate correspondence between the bark and the leaf; for, if we should remove the Almond branches, we might cause the several sorts of wood to develop buds and leafy twigs each of its own kind. Each section of the compound stem has its seat of life in the cambium layer, and the cambium of each reproduces cells of its own species out of a common nutrient fluid."

It is curious to note that the Gooseberry will not grow on any of the edible Currants, but flourishes on *Ribes aureum;* and it is singular to observe that while the Pear is short-lived on the Apple as a stock, and but little better as a rule on the Hawthorn, it lasts well on the Quince. *Bignonia radicans* will grow and bloom on the Catalpa as a stock. The mysterious and unknown causes which govern the affinity of plants must be studied and solved in the garden, and here is a wide field of useful labour and research open to the cultivator; for theories deduced from dried specimens, however plausible, will never teach us how plants live and are made to work, although we may derive useful knowledge of structure and geographical distribution from study in the herbarium. Hybridising, or grafting, or both combined, will yet do much to settle the uncertainty which exists with regard to genera, species, and other artificial groups into which plants are at present divided; and here is a sphere of noble labour in which none need feel ashamed to bear a part. "And why graft at all?" some may ask; "is not each plant best on its own roots?"—to which we reply: Undoubtedly so, when in a state of nature; but when we improve plants by cultivation, selection, or hybridising, in giving them qualities which we desire they should have, we often weaken their natural constitutions; for plants, like animals, have to bear the ills as well as the advantages resulting from civilisation, so that what in their natural state would be superfluous, in the garden becomes desirable, if not absolutely essential. According to M. Baltet's work above cited, the objects of grafting are: 1st, To change the character of a plant by modifying the wood, the foliage, or the fruit which it is required to produce.

2d, To excite the development of branches, flowers, or fruit on the parts of a tree where they are deficient. 3d, To restore a defective or exhausted tree by the transfusion of the fresh sap of a vigorous kind. 4th, *To bring together on the same stem the two sexes of monœcious (or diœcious) plants, in order to facilitate* their reproduction. 5th, To preserve and propagate a great number of woody or herbaceous plants, for use or ornament, which could not be reproduced by any other means of multiplication. Many plants become changed by grafting; indeed most of the finer varieties of Pears grafted on the Quince are rendered dwarfer in habit, and the trees more prolific, than when grown on their own roots, or even when grafted on another kind of Pear as a stock. Some Grapes, again, are much influenced by the stock on which they are worked. Take for example the delicious Muscat Hamburg (Snow's), which in most cases bears irregular clusters disfigured by a large proportion of small or undersized berries when grown on its own roots, but which is found to set much more perfectly on the Black Hamburg stock, itself notable as being of robust constitution and a good setter. Among ornamental plants the same rule holds good in many instances. Take for example the crimson-fruited *Pyracantha japonica*, which is far more fruitful and ornamental when grafted on the Quince or Hawthorn than when raised in the ordinary way and grown on its own roots; and the same may be said of many other plants of which further mention will be made. One of the most curious instances of the beneficial effects of grafting is that of the Chinese Kumquat Orange (*Citrus japonica*), which absolutely refuses to bear well on its own roots, even in its native hills, but which produces heavy crops of its delicious egg-shaped fruits when worked on the hardy *Limonia trifoliata;* and Mr Robert Fortune, the eminent Chinese traveller, informs me that this stock is universally adopted for this fruit by the native gardeners in China and Japan. We have evidence which goes a long way towards proving that it is possible to obtain hybrid plants by grafting.—(See Herbert's 'Amaryllidaceæ,' p. 376.) *Cytisus purpurascens* is said to have been originated by M. Adam, a Parisian horticulturist, in 1828, and was produced by grafting *Cytisus purpureus* on the common Yellow Laburnum (*Cytisus laburnum*) as a stock. The branches below the graft produce common Yellow Laburnum flowers of large size, while those above the graft often bear small purple Laburnum flowers as well as reddish ones intermediate between those of the scion and stock in size and colour, and not unfrequently yellow and purple flowers are borne side by side in the same cluster. A curious instance of the effect exerted by the scion on

the stock was brought before the Floral Committee of the Royal Horticultural Society, August 4, 1875. Mr Smith of Worcester obtained scions of a golden-leaved Laburnum; and wishing to propagate it as a desirable ornamental plant, he increased it by budding the golden variety on the common green-leaved English Laburnum as a stock. The buds took kindly to the stock, and developed themselves even more luxuriantly than had been expected. The buds were inserted at two or three feet from the ground; and in the course of a few months, not only did some of the green-leaved stocks produce golden-variegated branches *below* the point of union, but pure golden stolons or "suckers" were thrown up from the roots. The Rev. M. J. Berkeley, in referring to this curious case at the meeting of the above date, stated that he had long held the idea that variegation was a disease, and he considered this instance as a proof that the disease which produces or is the cause of variegation is contagious, and in the case referred to he believed it was transmitted to the healthy stock by the diseased scion. At the same meeting, and *apropos* of variegation being transmitted to the stock by the scion, Mr David Wooster remarked, that on the late Mr J. C. Loudon's house at Bayswater was trained a plant of *Jasminum officinale*—the ordinary green-leaved type—which had been changed in a similar manner by the insertion of buds of a golden-variegated form. The buds inserted in this case did not grow—that is, did not throw out branches—but appeared to go blind, while the bark of the stock closed up around them and healed over. The following year, however, golden-variegated branches similar to those from which the buds had been taken made their appearance, and greatly added to the ornamental character of the plant. Facts like these go a long way towards proving that Potatoes might possibly have been changed by grafting the tubers, as was asserted by Mr Fenn and others a year or two ago. We learn from the 'Florist' that an instance of variegation induced by grafting has been observed in the nursery of Mr W. Paul at Waltham Cross. The variegated variety of the *Castanea vesca* had been grafted, standard high, on an ordinary green-leaved Sweet-Chestnut stock: the graft took, but from some cause or other afterwards died off; and subsequently a young shoot, with well-marked variegation on its leaves, broke out from near the base of the stem. The variegation is of a creamy-white colour, and marginal. Another well-marked illustration of the influence of scion upon stock in inducing variegation has been noticed in Mr Noble's nursery at Sunningdale. The golden-variegated Weeping Mountain-Ash, two years grafted,

standard high, on the common Mountain-Ash (*Pyrus aucuparia*), had in four separate cases thrown out from the stock variegated shoots—one from the very base close to the ground, and the others about half-way up, about three or four feet from the base. The variegation was whiter than that of the graft, and seemed to be first developed along the midrib of the leaflets, some leaves being only affected in this way, while others had the colour also developed along the course of the main veins. In Blair's 'Botanick Essays' (1720), p. 386, that author observes: "'Tis by the descent of the particles from the graft, and their reascent, that the variegations appear in the other parts of the shrub; a pregnant example of which happened to Mr Brigman, gardener at Hertford, who engrafting a Hedgehog slip into a Holly, the graft died, but another variegation afterwards appeared *below* it, and upon the same stock." So the old "gardeners" knew something of our present difficult questions, and were perhaps just as near their right solution as we are now. Among modern instances of "inoculation" we may mention the golden-blotched *Abutilon Thompsoni*, which often infects with its variation the green-leaved *A. striatum* on which it is worked as a stock; while a Mr Fairchild observed exactly the same thing in the case of a golden-blotched Passion-flower which had been budded or "inoculated" into a green-leaved stock as long ago as 1722.—(See 'Gardeners' Chronicle,' 1871, p. 1100.)

In the 'Revue Horticole,' vol. for 1873, a curious statement is made, to the effect that an Italian horticulturist, M. Zenone Zen, has contributed a paper to the Royal Institution of Venice, in which he declares that, after long study and experiment, he has succeeded in producing varieties of Roses by budding in a certain manner. Two well-known botanists were appointed to see M. Zen's mode of budding, but they could not detect anything unusual in his manipulations; notwithstanding which, when the plants operated on flowered, the blooms were different in form, size, and colour, from the varieties whence the buds had been taken, and these new characteristics become intensified with the age and vigour of the plant. The varieties produced are said to be permanent, and may be perpetuated by budding, layering, or grafting in the usual manner; and if the variety becomes lost, it can be reproduced by performing the original operation of budding again in M. Zen's secret manner, or under like conditions. Is this true? Before we condemn this as a *canard*, we must remember the curious effects which are not unfrequently obtained when variegated Hollies, Passifloras, Jasmine, Golden-leaved Laburnum, Abuti-

lons, &c., are budded on their green-leaved types as stocks. These cases prove that under some circumstances and conditions—of which, unhappily, we know but little—the scion influences the stock, and these indications are cropping up every day, if gardeners would but record them. That the stock influences the scion is a better-known truth; and a series of experiments with scions on a bare stock—*i. e.*, one from which all the leaves and shoots are removed in the usual way—and others allowed to bear their own leaves as well as those of the scion, would doubtless teach us much more about this mysterious reciprocal influence, and prove of vast practical importance besides. Do we not rob the stock of a deal of its power to ameliorate the scion, when we denude it of all its own leaves? We know also that graft hybrids of undoubted authenticity have been produced, and these show us the possibility of M. Zen's assertions being founded on fact, although it is hard at present to believe that such is the case. While we are left in suspense by M. Zen, however, let us not wait idly: there are suggestions in his assertions, and if we dig deep enough we may find gold.

Mr T. A. Knight was one of the first to point out the variability of the same varieties of fruits when grafted on *different* stocks, and in the case of Grapes we have the most ample proof of this fact. Thus at Battle Abbey are rods of Cannon Hall and Muscat of Alexandria worked side by side on the Royal Muscadine stock, and the result is compact well-set bunches far superior to those borne by the same varieties on their own roots, and otherwise in precisely the same conditions. Mr Hill of Keele Hall makes the following remarks in the 'Garden,' vol. iv. p. 334: "Some years ago we grafted the Styrian or Keele Hall Beurré Pear on the Citron des Carmes, which is one of our earliest summer Pears, and the result is that the Styrian, thus treated, is about three weeks earlier than the same kind on the ordinary Pear stock, and better flavoured." And again, in the same volume, p. 254, another correspondent writing from Merriott, Somersetshire, says: "The Rokeby Pear, taken from a tree worked on the Pear stock, was in every stage of ripening very bad, being dry and mealy; while the same sort worked on the Quince in the same ground was full of juice, melting, and deliciously flavoured, and was a fortnight earlier." Another instance is furnished by that fine-looking but rather delicate-constitutioned Grape, Golden Champion. This, when grown on its own roots, frequently comes blotched or spotted in the berry, and eventually rots, if not cut when it ripens. This is perhaps the result of its robust growth not

becoming properly ripened; or, as some put it, its "low maturative force." W. Newton, Esq., an eminent amateur fruitist residing at Newark, after failing with this variety on its own roots, grafted it on the Raisin de Calabre; and in point of colour, finish, and exquisite flavour, the produce of Vines so treated was wellnigh perfect. I might quote dozens of well-authenticated cases to prove that both stock and scion are influenced very materially for better or for worse by grafting, and carefully-conducted experiments and observations will doubtless demonstrate this fact still more fully and satisfactorily in the future. In 1721, Mr Fairchild made numerous experiments in grafting (see 'Gardeners' Chronicle,' 1871, p. 1100) to demonstrate the relative influence of the scion on the stock. Amongst other things, he grafted the "Holm" or evergreen Oak (*Quercus ilex*) on the common Oak (*Q. robur*) as a stock, the result being, that while the leaves of the deciduous stock fell in the autumn as usual, those of the evergreen scion remained just the same as if on their own roots. It is advisable that the vigour of the stock and scion be nearly equal, or if there is any material difference, it is best that the graft or scion be the most vigorous, just as is the case with the Apple on the Paradise stock, the Cherry on the Mahaleb, or when the Pear is worked on the Quince; yet, at the same time, the stock should be perfect of its kind, not weakly or diseased in any way. The same precaution is necessary in selecting scions, which should always be the cleanest and most perfect growths on the parent tree; and if any difference as to earliness or forwardness of growth exists, it is best that the stock be in the most advanced stage. Grafts of Apples, Pears, and other deciduous trees and shrubs, may be cut in the autumn or during mild weather in winter, and kept in a fresh and dormant state by covering them with a coat of moist sand, or they may be buried in a north border until the stocks are ready for working. In some cases, where it is necessary to transplant stocks late in the winter or spring, they may be taken up and grafted in the propagating house or shed, and immediately planted out in the nursery quarters, or where they are to remain. In the case of young trees or shrubs, where the size of the stock and scion is generally equal, it is also advisable to match the age or texture of the two surfaces to be joined as nearly as possible, in order to secure an intimate union; but this is not so essential as it at first sight appears, because the texture of the inner layers of bark, and the cellular partly developed sap or "cambium," is pretty nearly the same in all cases, and this fact renders grafting so easy in the case of

nearly all woody or cellular (herbaceous) exogenous stems. In the case of young seedling stocks, where the size varies from one-eighth to half an inch in diameter, one, or at most two scions are sufficient; but in the case of old stems of Apple, Pear, and other fruit-trees which are to be renovated by grafting, half-a-dozen or more cleft grafts may be inserted so as to increase the chances of success, it being easy to thin out some of them with the knife if more grow than are required. The best season for grafting hardy trees is undoubtedly in the spring, when the sap is in motion; but by growing the stocks in pots, and taking advantage of artificial heat and moisture, the operation may be performed nearly all the year round. Azaleas, Camellias, Allamandas, Franciscea, and many other stove and greenhouse plants, and even hardy shrubs, as Conifers and Roses, are often more successfully operated on under glass. The genial heat and humidity of a propagating house or case greatly facilitates the union of scion with stock, by quickening vegetation, and inducing the junction of the generative cambium layer, by which alone the union can take place, and the operator should always bear in mind this fact, and aim at quickness and neatness in applying the inner layer of bark and the cambium layer *exactly* one upon the other. The blade of the grafting-knife should be as smooth and as keen as possible, so as not to bruise or mutilate the tissues; and both graft and stock, if small, should be prepared by the smallest possible number of clean and decided cuts. Quickness is requisite to prevent the delicate tissues from drying during the operation, and after the scion is accurately fitted in its place, care must be taken not to shift it in any way when tying or binding.

Embryonic grafting or inarching is not unfrequent in nature, although apparently accidental, and is the result of young tissues being pressed firmly together when in a pliant and plastic state. In 1870, Mr T. Meehan observed that about two per cent of young Osage Orange plants (*Maclura aurantiaca*) were united twins, and the pairs of young stems thus joined appeared to have sprung from the same seed, and not being separated by any intervening tissues, they had fused themselves together. In alluding to this subject (see 'Gardeners' Chronicle', 1871, p. 104, 199), the editor observes that the fact of two embryos being in the same seed is intelligible enough, seeing that several germinal vesicles are developed in the same sac, and it is possible for more than one of these to become fertilised, although the reverse of that is generally the case. Duplicate germs or embryos are common in the

Orange (*Citrus Aurantium*), and several instances are cited in Lindley's 'Theory of Horticulture,' as well as in Masters's 'Vegetable Teratology.' Mr Thwaites mentions the case of a Fuchsia which developed two plumules from one seed, in a similar manner to the Osage Orange plants above alluded to; but this case was even more singular, since the two plumules differed very much from each other—a fact attributable to their hybrid origin, the seed which produced them having been the result of a cross effected between *F. magellanica* and *F. fulgens*, the latter being the pollen parent. Lateral fusion, or "fasciation," is a developed form of natural embryonic grafting or inarching, and may be seen in Asparagus, Cotoneaster, Cucumbers, and in the crested varieties of Celosias or "Cockscombs." By noting the fact that nearly all young growths, such as stems or fruits, unite readily when in a young state, the intelligent propagator has long practised an adaptation of this tendency towards embryonic union or lateral fusion, to which the name "herbaceous grafting" is applied; and in most good nurseries inarching stems when in a young and tender state, or before woody tissue has had time to form, is found to give a more intimate union, since woody tissues never unite, the point of union being the cellular tissues of the cambium layer. Cellular tissues, as the very young stems of woody plants, soft succulent stems, as in Cacti or fruits like Melons, unite over nearly the whole area of the cut parts if neatly fitted together. Herbaceous grafting deserves more general adoption by our propagators than is at present the case, as cellular tissues unite much more freely than any other; indeed, none other really unite. Almost all trees and shrubs may be so grafted; and even Quercus, Fagus, Walnut, Conifers, and other plants which do not readily "take" when scions of the partly hardened or ripe wood are used, succeed perfectly by herbaceous grafting. The operation is best performed in a close and genial temperature, the essentials being a scion of soft young growth, one to one and a half inch long, a stock with the sap in full action, and a humid atmosphere to prevent the leaves of the scion from flagging. If the leaves are large, they may be cut in half to prevent evaporation taking place too profusely. A knife of razor-like sharpness and quick manipulative skill are required; and in many cases it will be found that tying in the scions will not be requisite if both stock and scion are in the soft or herbaceous state, and the plants operated on are at once plunged in a close heated case, where the atmosphere is kept at nearly saturation point. By operating in this way, seedlings only an inch or two in height may be grafted on

other seedlings of commoner kinds, or on soft-wooded cuttings if the latter are preferable.

Hitherto we have spoken principally of stem-grafting, but some plants are grafted on portions of the underground stem, on the root, or on the tuber; and we have seen examples of fruit-grafting, one Gourd being grafted on another variety as a curiosity, and a number of such examples have been figured and described in the 'Revue Horticole.' Even leaves may be used as stocks on which to insert small branches as scions. "Among the plants which may be propagated from leaf-cuttings is the Orange; but it appears that it is possible not only to propagate the Orange in this way, but even to graft the scion upon the leaf as a stock. MM. Thibaut and Keteleer have accomplished this curious feat: A leaf-cutting was taken in the ordinary way, then a notch was cut on the under surface of the midrib, wherein a graft was inserted and kept in place by a ligature. The leaf-stalk produced roots. The graft 'took,' and its buds developed; a little stem was formed, the base of which consisted partly of the leaf-stalk and the median nerve of the stock thus rendered woody and persistent, partly of the scion. The leaf in this instance lost its usual transient character, and became woody and persistent like a stem." Root grafting is practised with Aralias, Clematis, Peony, Petrea, Bignonia, Wisteria, Dammara, and sometimes in the case of the Vine, the scion being inserted by cleft-grafting at the junction between the stem and root, and then the point of union covered with a mound of earth. Grafting eyes, or even shoots, on tuberous rooted plants, is practised in the case of the Potato, Dahlias, and some species of Ipomœa. Mr W. Spinks succeeded in propagating the Apple in the Royal Horticultural Society's Gardens at Chiswick, by inserting scions on pieces of root and burying them so as to cover the point of union with moist soil; and the Apple has been largely multiplied in Australia and California by this method, which owes its origin to the accidental arrival of scions of valuable varieties late in the season, when ordinary stocks were scarce, and the weather too hot and dry for working them in the usual manner with any chance of success. Roses are very frequently worked on the roots of the Manetti, and succeed well. The possibility of transplanting—*i.e.*, grafting blossom or fruit buds—during the autumn months was pointed out by Mr T. A. Knight in 1812 (see Trans. Hort. Soc., vol. ii. p. 7), and although scarcely practicable on a large scale, it is interesting to know it can be done. Rose-buds which contained the embryo flower were inserted in August on young

suckers, and produced finer flowers than they would have done on their native shoots. I allude to this practice here, and cite Mr Knight's paper, because so late as 1875 some French horticulturists have recommended the operation as a modern one.

In the outdoor grafting of fruit-trees and ornamental shrubs, some sort of covering must be employed to keep the tissues from becoming dried by the sun and winds. Thick cotton or woollen thread may be used for tying delicate plants; but for fruit-trees bast of Lime-bark is generally employed, and this, in the case of large or common trees, is generally covered with a thick layer of clay, well beaten together with about one-third of fresh cow-dung, and in old times this was frequently covered with a layer of damp moss. Clay luting is now, however, but seldom used, some sort of grafting wax or mastic being employed instead, and used either hot or cold, according to the nature of the composition. MM. Leroy of Angers, and Baltet, Troyes, employ a warm mastic made as follows: First melt together resin, 2 lb. 12 oz.; Burgundy pitch, 1 lb. 11 oz.; and at the same time melt separately 9 oz. of suet, and when this is thoroughly melted pour it into the resin and pitch, stirring the whole well together; at the same time add gradually 18 oz. of red ochre, keeping the whole well stirred, so that the ingredients may become intimately mixed. It should be of the consistence of glue, and may be warmed when wanted for use with a spirit-lamp or gas jet. An old paint-brush serves to apply the mixture, which excludes air or rain, and assists the tying material in holding the scion firmly in its place. Cold grafting wax or mastic made as follows is recommended by M. Rodemaekers of Maeseyck: Rosin, 12 oz.; hog's-lard, 2 oz.; alcohol of 30°, 2⅔ oz. Melt the rosin and hog's-lard together over a gentle fire. Take the vessel off the fire and add the alcohol as speedily as possible, and in small portions at a time, taking care to keep the mixture well stirred all the while. Then pour it into a tin box, which should be kept well closed until required for use. Those who do not care to make their own mastic can obtain no better than that manufactured by M. l'Homme-Lefort fils at Belleville. This is sold ready for use in tin cases, and answers every purpose admirably. Mastics are principally used in the outdoor grafting of fruit-trees, but are also useful in the heated propagating house. It is necessary to tie all outdoor grafts firmly to a stake, or to the stock when practicable, otherwise they are extremely liable to be wrenched out by high winds, and thus a season is lost unless the damage is at once made good by budding.

"Double grafting" * is a comparatively modern practice, principally resorted to in the case of delicate-rooted varieties of the Pear, of which such as Seckel, Van Mons, Beurré Flou, Huyshe's new varieties, and others, may be cited as examples. Some Pears do not bear well on their own roots, neither will they flourish on the Quince stock; yet when some strong-constitutioned Pear is worked on the Quince, and used as an intermediate or go-between stock for a delicate variety, or one which does not coalesce perfectly with the Quince stock, excellent results are obtained. In soils which do not suit the Quince, but in which the Pear luxuriates, this order may often be reversed by using some good-constitutioned Pear as the root-stock on which to graft the Quince, which again in its turn is worked the following year with the kind of Pear desired to form a fruiting specimen. Mr Rivers of Sawbridgeworth has tested "double grafting" in this country, and speaks well of the results in the case of particular varieties.—(See Pyrus.) M. Baltet has the following remarks on this subject: "Those kinds of Pear which do not answer well when grafted directly on the Quince—such as Abré Courbé, Beurré Bretonneau, Beurré Spae, Beurré d'Apremont, Grand Soleil, Marie Louise, and others—may be grafted in the intermediary way on a hardy kind which has itself been previously grafted on the Quince—such as Bon Chrétien d'Été and de Bruxelles, Jaminette, Monseigneur des Hous, Curé, &c. These may be grafted the second year with the tender kinds. In the nurseries at Vitry-sur-Seine they employ the variety Curé, while at the establishment of MM. Jamin & Durand at Bourg-la-Reine they prefer the Jaminette. The same mixed method is used to obtain tall standard Pears on the Quince. The vigorous kinds, as Beurré d'Amanlis, Beurré Hardy, Madam Favre, and others, form stems directly, and serve as intermediary tall standard stocks

* One of the earliest records of double grafting I have seen is in Parkinson's 'Paradisus' (1629), p. 540, in which he gives a most interesting account of stocks to be used, &c. Speaking of the red Nectarine, then the rarest and dearest of all fruit-trees, he remarks: "The other two sorts of red Nectarins must not be immediately grafted on the Plum stock, but upon a branch of an Apricock that hath been formerly grafted on a Plum stock;" and it is further interesting to find the white Pear Plum, described as the "goodliest, freest, and fittest" of all stocks for Peaches, Nectarines, and Apricots. Parkinson here uses the word grafting in its widest sense; and his remarks on "double grafting" are corroborated by another intelligent old author, R. Austen, who, in his 'Treatise of Fruit-Trees' (1655), p. 57, makes the following statement: "But I hold it best to inoculate the *Roman red Nectrine* upon the branch of an *Aprecock* which before hath been inoculated upon a good *Plum stock*, that it may give not only a larger but a finer nourishment than ordinary *Plum stocks* can doe."

for other kinds. M. Carrière, head nurseryman at the Museum Paris, has shown us grafted close to the ground on Quince stocks some fine specimens of those kinds of Pears which generally do not take well on the Quince. He had, without using an intermediary, employed cleft-grafting instead of budding in their case." At a meeting of the Royal Horticultural Society, December 15, 1868, Mr Hames exhibited fruit of the Bess Pool Apple, one sample being produced from a Crab stock, while the largest and finest fruit was from a scion worked on a Pearmain branch which had previously been grafted on the Crab. The fruit produced by the double-grafted stock was by far the handsomest, and points to further intelligent experiments in double grafting the Apple, which, together with Plums, Cherries, and other hardy fruits, ought to be as much benefited by the process as is the Pear. It has often occurred to me that double grafting might be employed in the case of the Vine, and more especially for such varieties as Golden Champion, Golden Hamburg, Muscat Hamburg, Cannon Hall Muscat, and others of weak constitution. Fruit of the white Almerian or "Bowker" Grape, so largely seen during autumn and winter in Covent Garden and other fruit markets, will keep fresh and good for four or five months after being cut from the Vine, and this without any great care in handling, as must be patent to every one. Surely this robust and excellent keeper, flavourless though it be, might be used as a stock for late-keeping Grapes; or it could be improved by crossing it with pollen from other good-flavoured kinds, and so be made the forerunner of a race of excellent late-keeping varieties.

Cutting and Storing Grafts.—There is no better time to cut grafts than at the commencement of winter. In cutting and packing them away, there are some precautions to be observed. In the first place, let them be amply and distinctly labelled, as it is very annoying to find the names gone at the moment of using them. For this purpose they should be tied up in bunches, not over two or three inches in diameter, with three bands around each bunch—at the ends and middle. The names may be written on a strip of Pine board or lath, half an inch wide, a tenth of an inch thick, and nearly as long as the scions. This, if tied up with the bunch, will keep the name secure. For convenience in quickly determining the name, there should be another strip of lath, sharp at one end, and with the name distinctly written on the other, thrust into the bundle with the name projecting from it. If these bunches or bundles are now placed on end in a box with plenty of damp moss between them and over the top, they will keep in a cellar

in good condition, and any sort may be selected and withdrawn, without disturbing the rest, by reading the projecting label. We have never found sand, earth, sawdust, or any other packing substance, so convenient, clean, and easily removed and replaced, as moss, for packing grafts. It is needful, however, to keep an occasional eye to them, to see that the proper degree of moisture is maintained—which should be just enough (and not a particle more) to keep them from shrivelling. They must, of course, be secure from mice. Plum grafts, which are sometimes injured by intense cold, are generally better if cut before the approach of the severest weather and securely packed away.

STOCKS AND SOILS.

Some stocks are best suited not only to particular soils and climates, but even to particular varieties in the same situations. M. Dubreuil, an intelligent horticulturist at Rouen, conducted some experiments on the common stocks used for the Apple, Pear, Cherry, and Peach. His garden was situated on the ramparts of the town, and consisted of calcareous or chalky loam, in which, as related by Lindley, neither the Plum nor the Wild Cherry would succeed for stone-fruit, nor the Doucin or Quince stock for Apples or Pears, while the Crab suited the Apple, the Wild Pear the cultivated varieties, the Almond the Peach, and the Mahaleb the Cherry. The result of M. Dubreuil's observations, as given in the Trans. Hort. Soc., vol. iv. p. 566, is tabulated below:—

Fruits.	Loamy soil.	Chalk soil.	Light soil (sandy)
Apple.	Doucin.	Crab.	Doucin.
Pear.	Quince.	Wild Pear.	Quince.
Plum.	Plum.	Almond.	Almond.
Cherry.	Wild Cherry.	Mahaleb.	Wild Cherry.

This question of the best stocks for different soils, and different varieties even of the same species of fruit-trees, has long puzzled intelligent horticulturists; and from an interesting paper by Mr T. A. Knight (see Trans. Hort. Soc., vol. ii. p. 19) we learn that Continental fruit-growers have long directed attention to this intricate subject, and suitable stocks of different species even have been long used to counteract the disadvantages of unfavourable soils, the excess of vegetative growth,

and other constitutional peculiarities, which nothing short of a lifetime of devoted study can discover and turn to the best account. Thus the Peach grows tolerably well on three other stocks besides the free stock or seedling Peach; and the Plum, Almond, and Apricot stocks for this fruit have each their advantages and drawbacks in different soils. The French growers find the Apricot stock succeed for Peaches where both the Plum and Almond fail; but nurserymen, as a rule, prefer either the Plum or free—*i.e.*, seedling—Peach stock, and the last named conduces most to longevity and vegetative growth; indeed, Mr T. A. Knight's conclusions as to the use of stocks are, "that a stock of a species or genus different to that of the fruit to be grafted upon it can rarely be advantageously used, unless where the object is to restrain vegetative growth, and to enhance fertility or sexual vigour for a time; and even where the same species are used as stock and scion, he recommends the selection of varieties which resemble each other in habit and vigour, if durability is desired."—(See Trans. Hort. Soc., vol. ii. p. 199: 1816.) Longevity in fruit-trees is now rarely desired, since in the best fruit-gardens low bush trees are grown, and a number of stocks are annually worked with the best and safest varieties, so that directly a tree shows signs of weakness or infertility, it is at once grubbed up and replaced with a bearing tree; and it is a well-known fact that bush fruit from young trees is the finest, and consequently commands the best sale. It should always be borne in mind that our fruit-tree culture is unnatural—that is, we do not want a crop of natural fruit, but enormous crops of unnatural ones: that is to say, the more the succulent seed-vessel exceeds the seeds in proportion, the better we are pleased. Everywhere the demand is for heavy crops of large-berried Grapes, or enormous Apples and Pears.

MODES OF GRAFTING.

There are fully one hundred different—that is to say, slightly different—modes of grafting and budding,—*i.e.*, bud-grafting; but I shall here confine myself to the best and most generally adopted modes. The different methods employed in cutting and fitting the scions and stocks together are of minor importance in comparison with the time the operation is performed—that is always when the sap of the stock is in motion—the healthy vigour of both stock and scion, and the exact juxtaposition of the cambium layers in each. A warm genial temperature and a slightly humid atmosphere also conduce largely

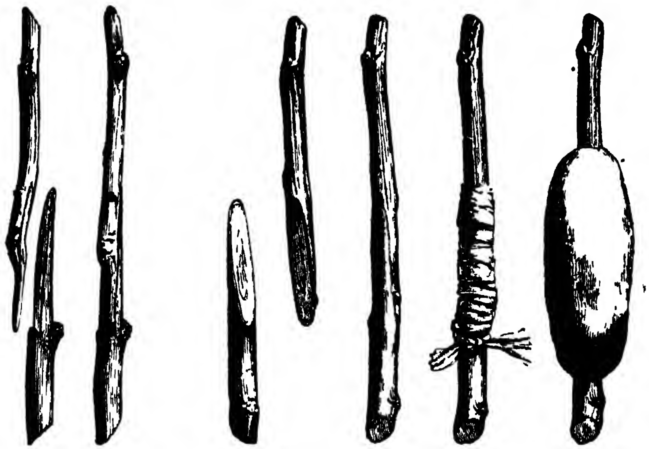
towards success. It may be as well if I here explain the term "cambium layers"* a little, as it is a term apt to be misunderstood; and it is very important that the reverse of this should be the case, since nearly the whole success of grafting, no matter what method may be adopted, depends on the cambium layer of the scion being in contact with that of the stock. The accompanying illustration shows the relation of the parts of an exogenous stem, the white dotted ring representing the cambium layers; and fewer disappointments will be experienced if it be remembered that the junction between the scion and the stock takes place only when these tissues are brought into contact. In "splice" or "tongue" grafting, this is done by applying the oblique or diagonal sections to each other, while in "crown" and "veneer" grafting, in "grafting by approach" (inarching), and also in "budding" or bud grafting, the same result is obtained by the contact of upright or vertical cuts or sections. The following directions as to setting the scion on the stock, from a 'Treatise of Fruit-Trees' by R. Austen (1655), are so exact and to the point that I here reproduce them. "And in setting in all grafts into the cleft, observe this for a *most special rule to joyne the inner side of the barke of the graft to the inner side of the barke of the stock*, that the sap may more easily come out of the *stock* into the *graft* to feed it, for the main current of the *sap is betweene* the bark and the wood. And regard not the custom of many grafters in setting the *outsides even and smooth*, not considering the *insides:* their successe is according to their skill for the most part. We know the bark of a big stock is much thicker than the bark of a slender graft, and if the *outsides* be smooth and *even*, the *insides* must needs be *uneven*. But I say to joyne *the inner sides of both barks together all along the cleft is the principal thing in grafting.*"

Section of Exogenous Stem, the white dotted ring representing the cambium layers

Splice-Grafting.—This is a simple method often adopted in the propagation of Roses, Azaleas, and other plants of slender growth, and when the size of the scion is the same as that of

* See a valuable paper on "Cambium" by W. R. M'Nab, M.D., in Journal of Botany, 1873, p. 13.

the stock. A clean oblique cut is made with a sharp knife, and the severed parts are then placed together as exactly as possible, and tied firmly with bast or cotton, a coat of mastic



Splice-Grafting the Peach *Splice-Grafting*

finishing off the operation. Plants of quick growth are readily propagated in heat by this method.

Whip or Tongue Grafting.—This is perhaps the most generally practised of all the methods, and is by French nurserymen termed the "English method." It is the same as the last named, with the addition of a slit or tongue in both scion and stock. These tongues fit together, dovetail fashion, and serve to hold the graft firmly in its place, and at the same time more uniting power is gained, since a larger area of cellular matter is brought into contact. If the scion is much smaller than the stock, it must be joined to one side of the stock only, as if placed in the centre of the stock the chances are that there will be no contact between the uniting surfaces of stock and graft. Our engraving shows this method, which, like the last, is generally adopted when scion and stock are equal in size.

Side-Grafting.—This method is the one generally adopted in grafting Camellias and other greenhouse or stove shrubs, and also for some hardy evergreens, as the Holly. The stock is not headed down as in the preceding methods, and two or three leaves are left on the graft. A slit or vertical cleft is made in the stalk with a sharp knife, and the base of the scion

is sliced into a wedge shape, and inserted as shown in our figure. In the case of the Camellia, the stocks are generally prepared in pots and grafted in this manner; and laid on their

Whip or Tongue Grafting

Side-Grafting

sides or sloped obliquely in a close propagating case, and in a moderate heat, they take very readily without any tying whatever. Gardenias also do well treated in the same way. Care must be taken to make the cut nearly vertical, as this does not weaken the stock so much as an oblique or deep cut, and exposes more uniting matter at the same time. This mode of grafting is well known to the Japanese, who largely practise it for the multiplication of Oaks, Kakis, &c.

Crown-Grafting.—This is a very useful mode, especially when the stock is much larger and older than the graft. As shown in our engraving, the stock is headed off, and a downward slit, say two inches in length, is made through the bark; one side of the bark only is raised if the scion is small, but both sides may be raised if it is a large one. The graft is cut sloping or wedge-shaped with a notch, and this rests firmly on the top of the stock. After

Crown-Grafting.

the graft is inserted between the bark and the wood of the stock, it is tied firmly and the union covered with clay or mastic in the usual manner. If the stock is large, two or more grafts may be inserted at equal distances apart. As will be seen, the stock in this case is prepared on the same principle as the stock in budding, only the top of the stock is headed completely off instead of the cross or T cut, and a several-budded graft is employed instead of a single bud.

Cleft-Grafting.—This method differs from the last, the wood of the stock being cleft or split so as to receive the scions, and it is generally advisable that the stock be larger in diameter than the graft. If the stock is of moderate size, the blade of the grafting-knife is placed on the top of the stock and pressed down so as to form a cleft. It is allowed to remain, acting as a wedge or lever to keep open the cleft while the scion is being inserted, after which it is withdrawn, and the elasticity of the stock closing together keeps the scion firmly in its place. As in the last mode, several scions (*b c*) may be placed on one stock (*a*) if of sufficient diameter, after which tie and anoint the union and top of the stock with mastic as usual. This method and the last are peculiarly adapted for renovating old fruit-trees which have previously been headed down for this purpose. Some, however, prefer to head them down the season before they are grafted, and then graft on the young shoots which they have made near the top by splice or whip grafting.

Cleft-Grafting.

Terminal Cleft-Grafting.—This mode is rarely practised, but deserves to be known, as it has succeeded with the Walnut, which is not one of the easiest of subjects to graft, and also in the case of some Conifers. The stock is not headed down as in the last method, but a vertical slit is made right through the terminal bud, as shown in our figure. The scion consists of a terminal shoot of two or three eyes, and is prepared by being sliced like a wedge at its base, and then fitted accurately into the slit in the stock. The genus *Pinus* may be propagated in this manner during July and August, or just when the scion and stock acquire the requisite consistence or density; or the shoot used as the stock may be cut off just below the terminal group of buds when the sap first begins to flow in the spring—say April or May. This is slit as in cleft-grafting, the leaves being removed just around the slit. The scion taken from

any desired variety consists of the young extremity of one of the branches with a terminal bud, and at this season will be soft or herbaceous, hence a keen blade must be used to cut it without bruising. Make two sloping cuts, one on each side, so as to make the base of the graft wedge-shaped, then insert it in the stock and tie it firmly in the usual way. Under glass this method succeeds perfectly. According to M. Baltet, there are specimens of *Pinus laricio* in the forest of Fontainebleau which were thus grafted on *P. sylvestris* (Scotch Pine) forty years ago; and he adds, "The trees are *as fine as if* they had been raised *from seed*." According to the same authority, M. Jules Barotte of Brachay (Haute Marne) has converted by this method thousands of *P. sylvestris* into *P. austriaca* and *P. laricio*. He operates in the open ground or in the forest, and grafts the subjects on young *leading* shoots at the height of two or three feet from the ground, and never covers his grafts with paper caps as they do in the nurseries—from which one may infer that this is a really excellent method of treating Conifers. This graft is bandaged with cotton or wool, and the air and rain excluded by mastic in the usual manner.

Terminal Cleft-Grafting

Fork-Grafting.—This mode is similar to cleft-grafting, but the fork between two young branches is selected and slit to receive a wedge-shaped scion having one or two buds as in the Beech and Vine; or in the case of Conifers the scion consists of a terminal shoot, the base being cut to a sloping or wedge shape, and inserted and otherwise treated as in the last method. M. Baltet recommends this mode in propagating Thuja, Biota, Chamæcyparis, Cypress, Juniperus, Retinospora, Thujopsis, and others. This method is best performed in spring, and the sap is attracted to the graft by shortening the ends of branches immediately *below* the graft.

Saddle-Grafting.—Camellias, Rhododendrons, and other evergreens may be propagated by this simple method, and it is often used in grafting succulent plants, as Cereus, Epiphyl-

lums, &c. In this case the apex of the stock is sloped upwards like a wedge, and the base of the scion is slit—the lower ends of the slit sides being thinned so as to fit the wedge-topped stock accurately. It is a simple and successful mode, which I have used in grafting *Ficus elastica* on roots of the common Fig with every success. It is principally employed when stock and graft are similar in size and consistence.

"*Budding*" *or Bud-Grafting.*—This method is very generally employed in the propagation of standard Roses on the Brier stock, and also in the propagation of Apples, Hollies, Chestnuts,

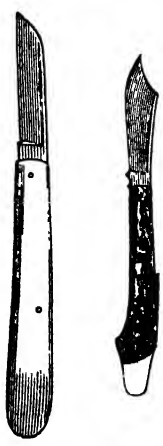
Saddle-Grafting *Hertfordshire Saddle Grafting* *Budding the Rose* *Budding reversed*

Cherries, Plums, Apricots, and many other hardy fruit-trees and ornamental shrubs. One advantage of bud-grafting is, that it can be resorted to when ordinary spring grafting has failed, and thus a season is saved. It is best to select plump but not bursting buds from the centre of a sound and healthy shoot, in preference to those at the base or at the apex. If they are not sufficiently forward, they may be hastened by pinching or stopping the end of the shoot. If, however, they are too forward in the centre, those at the base or near the apex may be used. It is best to cut the branches or shoots from which the

buds are to be taken fresh from the parent plant or tree as they are required for use; but as this cannot always be done, especially when buds are sent from a distance, care must be taken to keep them as fresh as possible during the journey and until they can be used. The best packing material is moist—not wet—Sphagnum moss, which should be wrapped around the shoots directly they are cut, covering this again with thin sheet india-rubber, or with a sheet of brown paper. I have received—thanks to many lovers of the Rose—buds packed in this way which have travelled hundreds of miles, and found them equal to fresh-cut buds. The buds must be cut with a keen blade, and the cut should be *always* made in the direction in which the shoot grows in this as in *all other modes* of graffage and pruning. Cut them as clean as possible just beneath the bark, with the thinnest shaving of the young wood. The shoot which is to serve as a stock receives a cross or T-shaped cut, and great care must be taken not to make the top or cross too deep, or the chances are that the top of the shoot will be blown off, and this endangers the safety of the bud. Some practitioners make no cross cut, but only a longitudinal one, and this answers perfectly, except that the bud is not so easily and quickly inserted as when the top cut is made. Budding is generally practised in May and June, and is most successful in warm, calm weather, with occasional showers. Deciduous plants, as Roses and fruit-trees, may have the blade of the leaf severed from the bud when the operation is performed out of doors, as if left on the petiole it is almost sure to "flag," or droop and fade; but in budding under glass, where a humid atmosphere can readily be maintained, the leaf, or at least half of it, may be left with advantage, as when it does not flag it helps to infuse life into the bud until the junction is effected with the stock, just as leaves on a cutting facilitate its rooting by causing it to callus sooner than if they were removed. In budding evergreens—as Hollies, &c.—leave the leaf entire. There is always greater chances of success if the bark of the stock rises cleanly and freely when the ivory end of the budding-knife is inserted to make room for the bud. After the bud is inserted, it has to be bound in its place with either worsted, thick soft cotton, or bast, and does not require a coat of mastic as a rule, although where the buds are but few, and time and labour no object, it certainly contributes as much to the success of a bud-graft as to that of any other kind. A considerable amount of practice is requisite to enable one to tie buds in well. M. Baltet recommends them to be tied by simply winding cotton or other material round above and

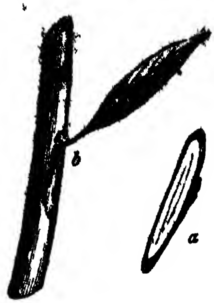
below the bud; but I prefer lacing—that is, taking one end of the tying material in each hand and crossing it over the slit, by which method both sides of the slit are drawn together, and more protection is thus given to the inserted bud than in the ordinary manner, in which the ligature pulls one side over the bud and the other side from it. Although the T-budding above described is the most generally adopted mode adopted in English gardens, there are several modifications of it adapted for different climates. In cases where the sap is too abundant, its ascent is checked by making the cross cut below instead of above the long or vertical cut, thus, ⊥. Where the bark of the stock is unusually thick, and the buds large, as in the Chestnut or Vine, the cross cut may be in the centre of the long one, thus, +, as this allows more room for inserting the bud-scion. Apricots and Peaches may be summer-budded on the Plum stock in this manner with success. All kinds of buds require tying to stakes or to the stock when they commence their growth, otherwise they are liable to be broken off accidentally or blown out by high winds, and this means the loss of a season's growth.

Shield-budding in spring is much practised by the Continental cultivators, and is found expedient at other seasons, in the case of Roses, Camellias, and many other flowering-plants. For deciduous trees, like the Apple and Pear, the buds are selected in autumn, and kept during winter attached to the shoots they are produced on, by placing their ends in the ground, as is usually done in the case of scions for grafting. In spring, when the sap is up in the stock, the buds are taken from the cuttings, and inserted in the following manner: A transverse cut is made by the common or the French budding-knife (see figs.) in the shoot containing the bud, a little below an eye; and this transverse cut is met by a longer incision downwards, commencing a little above the eye, taking great care that a portion of the wood is removed with the bark in which the bud is situated. The bark of the stock is then cut in manner resembling an inverted T. The greatest care should, however, be taken that the edges of both the cuts in the stock and bud be cut clean, so that they shall,



Common and French Budding-Knives.

when brought together, form a speedy and uniform union. In the case of the Rose, the stock should be pruned down, about eight days after the bud is inserted, to the shoot above it on the opposite side of the stock, which shoot should be shortened by being pinched back to two or three eyes, removing at the same time all the side shoots as they are produced; and when the shoot formed from the bud has extended to its fifth leaf, the point should be pinched off, which will cause it to branch out, and, in all probability, induce it to flower in September of the same year. The Rose is also budded in spring, even before the sap rises in the stock, in the following manner:



A niche is cut out of the stock, say an inch or so in length, as in fig. *b*. A bud (*a*) is taken of the same size and form, retaining a small portion of the wood; the bud is then nicely fitted to the niche, and secured by coiling a strand of soft matting round it. In the same manner the Camellia, Orange, and Rhododendron may be budded, only in their cases the entire leaf should be left attached to the bud. A modification of this manner is often resorted to in the case of the latter plants—namely, by taking a bud with a portion of the wood attached to it, and cutting out a similar piece from the stock, and substituting the one for the other.

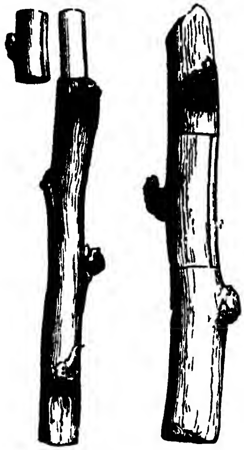
In the case of some very delicate plants, cotton wool or very soft moss is placed round the bud, and secured by passing a strong thread round it, to keep it firmly in its place. In ordinary cases, however, the expert budder uses nothing but fine strands of bast matting, and the success as well as the expedition with which this nice operation is performed in our British nurseries is truly wonderful.*

Flute-Grafting.—This plan is seldom practised, but is yet used in propagating Mulberries, Figs, Walnuts, and Chestnuts. Two horizontal incisions are made around the scion (in the spring, when the sap is moving), above and below one or more buds, and a downward or vertical slit between the two enables the operator to separate this short, flute-shaped piece of bark from the parent stem. A corresponding piece of bark is removed from the stock and thrown away, the piece from the desired variety being neatly and quickly substituted in its place. Sometimes, however, this piece of bark is not removed, but cut

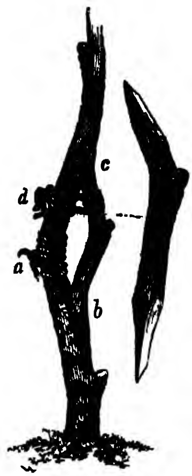
* Book of the Garden.

into strips, these being afterwards bound up around the graft. In both these methods the scion and stock should be as nearly as possible of the same diameter.

The following plan of grafting is adopted by some American horticulturists in the case of the Vine. After the sap is flowing in the spring, tie a ligature tightly around the stock (*a*), and in selecting the scion prefer one which is naturally bent, as in our



Flute-Grafting



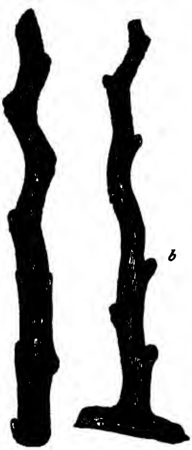
Bow Vine-Graft.

figure: cut two slits, as at *b c*, and then cut the scion a trifle longer than the distance between these cuts, and shape the ends in a wedge-shaped manner, but rather unequally, so as to avoid cutting the pith on one side. Insert both ends of the scion into the slits carefully, and if need be, secure it in its place, and increase its natural pressure on the cut surface by a ligature, as at *d*. If the operation is neatly performed no tying is required; but a coat of mastic should be applied to keep out the air and wet. After the union is thoroughly established, both stock and scion may be pruned or shortened as desired.

In France numerous experiments have recently been made with American Grape stocks, which, having vigorous roots, are able to resist the ravages of the *Phylloxera*. The grafting may be done in the shed or propagating-house, and, if tied neatly and anointed with mastic, is very successful; and specimens so

worked (see figure, *a b*) were exhibited at the Montpelier Viticultural Congress in October, 1874. In America Mr Cambre, a successful viticulturist at Nauvoo, Ill., has practised grafting the Delaware Grape very extensively, the stocks used being wild seedlings collected from the woods; and his Vines so treated are healthy and vigorous even in unfavourable seasons, when others not so treated fail completely in the same soil. *V. æstivalis* and *V. labrusca*, together with their cultural forms, made excellent stocks.

Grafting by Approach (*Inarching*).—This is perhaps the most ancient of all the modes of grafting, as it not unfrequently occurs naturally in tropical Fig-trees and in the Lime. In this



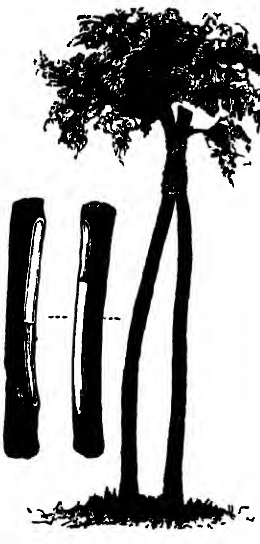
Saddle Vine-Graft.

Grafting by Approach or Inarching

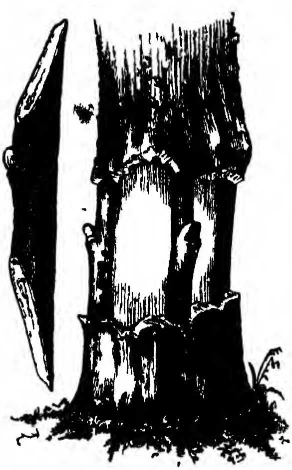
method both stock and scion are left on their own roots until a union takes place, after which the base of the scion is severed, and the stock headed down, so as to allow it to develop itself to its utmost extent. This plan is especially useful in filling up any naked spaces in Peach and Nectarine trees, or even in the Vine, a superfluous branch being simply bent down and spliced on the main branch just where it is required. Stocks may be grown in pots in cases where it is necessary or convenient to multiply plants in this manner. This plan is simple and tolerably sure, and can be modified in many ways by the intelligent propagator. It will be perceived that this kind of grafting

can be performed either to renovate old and naked portions of the parent tree, or, where two varieties or nearly-related species are growing in close proximity, they can be united or changed by this method. In Continental gardens we have seen some very complicated specimens of fruit-trees, every branch being grafted to its neighbour by this system, and the whole forming some fanciful design. Some intricate examples of this kind, which serve to illustrate the perfect mastery of the cultivator over the waywardness of fruit-trees, may be seen in the Peach Gardens at Montreuil, a small village a little beyond Amande, and in the Parc Vincennes, Paris.

It not unfrequently happens that young fruit-trees become injured by game or cattle in severe weather, the bark being



Stem replacing Graft



Bark repairing Graft.

gnawed off just above the snow-line in winter; and if the bark is completely bitten off all round, it follows that the tree will ultimately succumb unless some remedial measures be adopted. One of the best of these remedies is to insert scions, as shown in our engraving which, by uniting the separated barks, will restore the current of sap, and enable the tree to survive this accidental girdling. In the case of very young trees, however, a better plan is to take a stock and plant it near the damaged

tree, afterwards inarching the two stocks together just above the barked or damaged portion. After the union is effected, the old stock can be cut away. In most cases it is easier and better to grub up young damaged trees and plant others; but in the case of some new or rare fruit-trees or ornate shrubs, which are difficult to replace, devices like those here described are of great practical value.

Grafting Cuttings.—It often happens that certain species in a genus are readily propagated by cuttings, while others root slowly, or, as in the case of some Aralias, fail altogether. This difficulty can in some cases be overcome by grafting a cutting of the delicate or slow-rooting species on to a cutting of a species which roots easily, by simply splicing them together as shown in our engraving, or by cleft-grafting or inlaying. This plan is frequently adopted by Continental propagators, and is recommended by M. Baltet in the case of the Aucuba Mr T Baines, writing to the 'Gardeners' Chronicle,' says "I have made some experiments with cutting grafting before the cuttings were inserted in the striking pots, by uniting two cuttings of different varieties of the same species. If flowering-plants, the process was simply to unite the two cuttings from their base an inch or so upwards, by paring them down, so as to fit the two together, and securing them by a ligature of bast in their position before inserting the cuttings. In the manner indicated I once grafted cuttings of *Dipladenia crassinoda* and *D. magnifica*. the latter, as is well known by growers of these plants, is a stronger-constitutioned variety than the former; it is also profusely marbled with white over the surface of the flowers. The cuttings made roots, united, and grew on as nearly equal in size as possible, both coming into flower about the same time—the flowers on that portion of the plant composed of the variety *magnifica* being in no way different from their usual condition; but the whole of the flowers upon the *crassinoda* portion were marbled just similar to the other variety, at once showing that they were affected by the union."

Cutting-Graft

TABULAR VIEW OF THE PARTS OF PLANTS THAT MAY BE USED EITHER AS SCIONS OR STOCKS.

(If considerable difficulty is experienced in rooting cuttings of any exogenous plant, it may in most cases be surmounted by grafting cuttings of the young growth on bits of root well furnished with fibres. In the case of cultural varieties, roots of the typical species may be used for this purpose, while the roots of nearly allied but less valuable species are often procurable Cleft or splice grafting in a close heated case is rarely unsuccessful)

STEMS	TUBERS	ROOTS
Fully ripened shoots of current or preceding year's growth, as Apples, Pears, &c	Potato by splice or wedge grafting	New or rare Roses by splice or cleft grafting on Manetti, common Rose, or Wild Brier roots
Young growth of Conifers and evergreen shrubs, &c , by splice, terminal cleft, side, or whip grafting in open air or in heat	New or rare varieties of Hollyhock on the crowns of common or single kinds by splice or cleft grafting or inlaying	Apple Pear, &c , on own roots, or on roots of Crab, Doucin, Wild Pear, or Quince
Herbaceous or very young stems before the cellular tissues begin to harden as in the case of the young laterals or footstalks of the Grape Vine Peaches by inarching to fill gaps &c	Dahlias shoots from large growing kinds as *D imperialis*, or from new varieties inserted on tubers of common kinds by cleft or wedge grafting	*Eriobotrya japonica* on collar or root of Medlar or Quince, Dammara on own roots
Succulent stems as in the case of Epiphyllums Euphorbias Mammillarias Echinocactus, &c on Cereus stocks, grafted Gourds or other fruits	*Ipomœa Horsfalliæ* on tubers of *I (Batatas) paniculata* or other tuberous species, ornamental foliaged Dioscoreas on tubers of common Yams	Clematis new or rare kinds on roots of common sorts *Ficus elastica*, *F Chauvieri* &c on roots of common Fig (*F carica*)
Eyes from young growth on young shoots as in the case of budding Pears Hollies stone fruits and rare deciduous or evergreen shrubs	Gloxinias, new and rare kinds may be worked on the tubers of common seedling sorts, as in Dahlia this is, however, but rarely resorted to, as these plants are more easily propagated from leaf-cuttings	Vine by splice or cleft grafting on roots of common sorts
Eyes from fully ripened wood when dormant, as in the Grape Vine, &c		(Even leaves may be grafted where they are of a permanent and succulent or cellular character In the Jardin Muette at Paris I saw a plant of Pachyphytum which had a young scandent Crassula depending from the point of each leaf, this having been the feat of a clever propagator, who wished to amuse his non horticultural visitors with something wonderful This might be done as a curiosity in many other cases, especially amongst succulent plants.)
(Grafting is mostly performed with wood buds but it has long been proved by T A Knight, Esq , and other scientific horticulturists, that bloom or flower buds may be removed from fruitful branches and inserted in barren ones in the autumn with every success, and a crop of fruit thus insured where otherwise even flowers would not have been produced)		

GENERAL REMARKS ON HYBRIDISING AND CROSS-BREEDING.

"One new variety raised by man will be a more important and interesting subject for study than one more species added to the infinitude of already recorded species."—DARWIN: *Origin of Species*.

"Nature abhors perpetual self-fertilisation."—DARWIN: *Fertilisation of Orchids*

"Let us follow in Darwin's wake. . . . There is romance in the pursuit, and laurels to be gathered by every acute, industrious observer."—J. ANDERSON-HENRY.

PREVIOUS to entering on this subject, it may be as well to remember that nature has for ages gone on improving plants by natural cross-fertilisation and natural selection, or, as some prefer to put it, "the survival of the fittest." Sir John Lubbock, in his interesting little work on 'Flowers and Insects,'* tells us that flowers owe their brilliant colours in a great measure to the kindly offices of their winged visitors and guests—insects; and in this opinion he is borne out by other observers, and a numerous array of facts. In dull-coloured or inconspicuous-flowered families, odour supplies the place of light colours; and those plants which bloom at night, such as Œnotheras, Yuccas, Cacti, and some Orchids, are in nearly every case white-flowered, and sometimes powerfully scented. But nature does not always work in precisely the same groove, and it is very probable that colour, odour, and nectar or honey, are alike attractive to insect life, and thus indirectly aid in that gradual change, or rather grand series of changes, which is continually taking place in the plant world, and which has doubtless been going on more or less ever since the wind has swept over nature's "wild garden," and the insect has rifled sweets from honey-laden flowers. A correspondent of 'Nature' advances the following argument to show that the colours of all flowers and plants are not due

* Macmillan, Bedford Street, W.C. See also a valuable paper in the Journal of Botany, 1873, p. 11, on the "Influence of Insect Agency on the Distribution of Plants," and "Heredity and Hybridism," a suggestion by E. W. Cox, S.L. (Longmans).

to insect agency;—for instance: 1. Cultivation increases the size and colour of flowers quite independently of the existence or non-existence of insects. 2. Double flowers, in which the doubling arises from metamorphosis of stamens or pistils, are more showy than the single forms; yet insects can be of little use to them, since they are either partially or entirely barren. The double-blossomed Cherry is brilliantly conspicuous, but it bears no fruit. 3. Such abortive flowers as the cultivated Guelder Rose and Hydrangea depend for their beauty upon the destruction of the reproductive organs. If their increased splendour is meant only as a lure to insects, it is surely an absurd failure. 4. The autumn colours of leaves and fruits* can serve no such purpose, yet these are often as bright and conspicuous as the flowers of summer. 5. Fungi and Lichens exhibit brilliant colours, which can have nothing to do with insect-fertilisation. Do not these facts indicate, that though insects may be attracted by conspicuous colours, and may have some influence in the maintenance of coloured species, there is yet a deeper and more permanent cause for the colour itself?

Insects and Colour of Flowers.—It is a curious fact that nearly all night-blooming plants bear white flowers, and many species of Cactaceous plants, especially Cereus, may be cited as examples, together with long-spurred, nectar-laden Angræcums and noble Yuccas; while a further notable fact in connection with night-flowering plants is, that their fragrance is scarcely perceptible during bright daylight, and is almost overpowering at night, especially in a hothouse or close room. Here the colour and fragrance seem specially adapted to attract the attention of nocturnal lepidoptera or other insects. The theory that flowers owe their bright colours to insect agency is supported by the fact, that in the natural order of Orchids we have the most lovely and varied of all floral beauty; and this order is singularly indebted to insects, without the assistance of which, indeed, Orchid flowers cannot become fertilised in their native habitats. Asclepiads in like manner are mainly dependent on insect agency, just like Orchids; but in the first-named group nectar would seem to be the principal attraction; while in the case of Orchids, colour and fragrance seem the charms to lure the little "winged messengers of love." My object here, however, is not to do what Darwin, Lubbock, Huxley, and others have already done before me, but to show

* The beauty of fruits, as shown by Prof. Hildebrand and Mr Darwin (Origin of Species, chap. vi.), "serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the seeds disseminated."

as clearly as possible how plants may be artificially fertilised so as to change and if possible improve them, either in use or beauty. Cross-fertilisation seems in many cases to infuse fresh life or additional vegetative vigour into cultivated seedling plants, besides changing them materially in habit and colour of flower, or in the size and flavour of their seeds or fruits.

Increased Vigour.—I have in several cases noted the healthy vigorous appearance of Mr Dominy's hybrid and bigeneric hybrid Orchids compared with the parent plants, and *Cypripedium Harrissianum* (*C. barbato-villosum*) or *Calanthe Veitchii* may be cited as examples, being more robust than either of their parents, and more profuse bloomers; but in some cases we find that this vigour is at the expense of fertility in the hybrid, hence they are called mules. In the animal kingdom, also, this hardy vigour seems transmitted to sterile hybrids, the mule being capable of more prolonged exertion than either the horse or the ass. But while the occasional infusion of fresh blood by cross-fertilisation is beneficial and invigorating to either animals or plants, cross-breeding in-and-in very often produces weakly and debilitated progeny. Some few hybrids or mules between distinct species are sterile or barren in the first generation, while on the other hand crosses between two forms of the same species are not unfrequently more vigorous and prolific than their parents in growth, flower, and fruit while under cultivation; but it will be found that they possess far less "staying" power, and either revert to the normal type or die out, if they have to compete with other vegetables in the universal struggle for existence. It is curious to observe that varieties in some cases cannot be crossed; while some plants, like *Tacsonia*, are more readily fertilised by the pollen of other species than by that from their own flowers. Hybrids also vary from complete or even increased fertility to entire sterility. I particularly wish to point out that all our improvements, however valuable they may be in a state of cultivation, either for use or ornament, are actually inferior to their wild parents when relegated to a state of nature; and this is a most important fact, and one which proves the unyielding pressure of that curse which the first gardener incurred in the first garden.

Natural Cross-fertilisation.—We need not here look into the mysteries of irritable or dimorphic stamens, elastic glutinous caudicles, and the many other simple or intricate arrangements by which nature secures that occasional cross so essential to prolonged fertility and vigorous heatlh, since the works of Darwin, Lubbock, and others explain all these devices fully, so far as is

at present known. It is sufficient for us to know that the organs of most plants are naturally adapted so as to secure fertility and cross-fertilisation occasionally; so that artificial cross-fertilisation is but an attempt on our part to "mend nature, *change it rather*, —the art itself is nature." A very interesting paper on the subject of cross-fertilisation by insect agency and natural self-fertilisation, by Mr Meehan of Philadelphia, will be found in the 'Gardeners' Chronicle,' 1875, p. 327, 328. In this paper he names a variety of plants which are self-fertilising according to his experience, and draws attention to the fact that the way in which plants are fed influences their fertility to a much greater extent than is generally supposed. According to Mr Meehan, the degree of nourishment which plants obtain has a very wonderful influence on their sexual organs: indeed his conclusion is that female flowers are produced only in the best conditions of vegetative vigour, while with a weakened vitality comes an increased tendency to bear male flowers; and when we consider the occasional appearance of male and female flowers simultaneously on such diœcious plants as Cœlebogyne, Humulus, Aucuba, many Palms, and Araucaria, this view seems not only possible but also probable. From the facts given in the paper above cited, Mr Meehan deduces the following statements:—

1st. That the great bulk of coloured flowering-plants are self-fertilisers.

2d. That only to a limited extent do insects aid fertilisation.

3d. Self-fertilisers are every way as healthy and vigorous as, and immensely more productive than, those dependent on insect aid.

4th. That where plants are so dependent, they are the worse fitted to engage in the struggle for life, the great underlying principle in natural selection.

One great fact in reference to this fourth deduction should not escape our notice—viz., that all the plants which require insect agency to enable them to produce seeds are singularly deficient in economic value, so far as our knowledge now extends. Fancy the millions of flowers produced by our cereal crops requiring insect agency, and note how perfect is the fertility of our corn plants, nearly every flower in a head of wheat or barley becoming fertilised and developed with a precision and exactness that would be marvellous had we not learned to regard the whole performance as a mere matter of course.

It is very singular to note the precocity of some seminal

varieties, and this tendency appears to be favoured by bad culture. Seedling Fuchsias, if starved, frequently flower when only an inch or two in height; and in a recent number of the 'Revue Horticole,' figures are given of an *Ailanthus* seedling* which produced flowers when only four months old, and when the seed-leaves were still attached to the plant. The flowers were male. It is possible that a similar case figured in the 'Gardeners' Chronicle' was also a seedling, but we had no opportunity of ascertaining whether this was so or not. M. Carrière also figures a Weigela which flowered when little more than an inch in height. More than 200 seedlings showed the same precocity, and *Rhamnus oleæfolius* and *Pavia hybrida* have been observed by M. Carrière to present the like phenomenon.

A seedling Cocoa-nut Palm (*Cocos nucifera*) is figured in the 'Gardeners' Chronicle,' 1873, p. 213, and this bore both male and female flowers on a curved branched spadix long before the plant assumed its pinnate foliage. A whole race of dwarf Rhododendrons was raised by Messrs Standish & Noble prior to 1850 (see Rhododendron); and it appears possible for the intelligent cultivator and hybridiser to originate and select some dwarf and precocious races of our most popular flowers, as well as of those plants which, like Brownea, Amherstia, Æsculus, and other trees and shrubs do not naturally flower in a small state, by taking advantage of nature's variability or precocious sportiveness, induced by cross-breeding or cultivation, since whenever a break is obtained in any given direction, the perfection of such variations is merely a work of patience and perseverance. Poor soil and a light dry atmosphere are favourable to either dwarf or variegated plants, and also facilitate the production of flowers. A moist genial temperature, with plenty of light and sun-heat, greatly assists fertilisation by hastening the growth of the pollen-tubes; and careful selection of plump, well-ripened seeds, from such individuals only as come nearest to the desired standard of assumed perfection, must be specially attended to as one of the most potent helps towards the desired end.

The late Dean Herbert, writing as long ago as 1842, remarked that a skilful application of these apparently simple but natural means would seem to be the medium by which it was intended that the life and energy, beauty and variety, of the vegetable kingdom should be made subject to the control of man;

* M. Carrière figures a tree of *Ailanthus glandulosus* in the 'Revue Horticole,' 1872, p. 234, which bore male and female flowers on separate branches.

and all that has yet been accomplished in this way appears but as scattered fragments, compared with what may be expected when this sacred enclosure of nature has fully yielded itself up to the researches of science and philosophy. Enough has been already secured to encourage and stimulate future effort.

There is considerable analogy between seeds and buds; and bearing this fact in mind, it is singular to notice that some buds which ought normally to have produced leafy branches and flowers the year following, bear a confused cluster of leaves and flowers together. This may be often observed on badly-ripened growths (pseudo-bulbs) of *Dendrobium chrysanthum* and *D. nobile.* In both cases deficient nutriment is one of the causes of these phenomena. The case of the Ailanthus cited above bears out Mr Meehan's theory—viz., that a weakened vitality tends to the fuller development of the male organs; and in connection with this theory it would be interesting to experiment with those plants which, like *Narcissus biflorus*, *Verschaffeltii*, and many others, are known to be deficient in pollen, as possibly a course of starvation might cause its development, and so enable us to obtain hybrids otherwise impossible. Many plants, if in ill health, or if half starved, are far more fertile than when amply nourished; and weakly or decaying fruit-trees often bear enormous crops, which is evidently a strenuous effort towards reproduction; and a knowledge of this fact may be of great service to the intelligent hybridist.

Object and Results of Hybridisation.—"Can anything be more striking than the effects of hybridising upon Pelargoniums, Heaths, Gloxinias, Verbenas, and Gladioli? By this process we have given to the hardy Pears of the north all the richness and delicacy of those of the south, to watery and flavourless Grapes the perfume of the Muscat, to the pale-faced but hardy Rhododendrons of Caucasus and America the rich and glowing colours of their tender brethren of India, to the gaudy Azalea of Pontus the crimson of the small-flowered fragrant species of the United States.

"Hybridising is a game of chance played between man and plants. It is in some respects a matter of hazard; and we all know how much more excitement is produced by uncertain than by certain results. What increases the charm of the game is, that although the end of it may be doubtful, yet a good *player* can judge of the issue with tolerable confidence, and that skill and judgment have in this case all their customary value."—(Lindley.)

It has often been said that the results to be obtained from

crossing two species are irregular; and to a certain extent, undoubtedly, these assertions are true. We have instances, however, in which the same hybrid has been obtained by two different raisers; and Mr J. M'Nab, in his presidential address to the Botanical Society of Edinburgh, pointed out that some hybrid Rhododendrons can be produced at will by crossing certain species. The late Mr James Cunningham, of the Comely Bank Nurseries, Edinburgh, raised the hybrid *Bryanthus erectus* by crossing *Menziesia cærulea* with pollen from *Rhododendron chamæcystis*; and Mr J. Anderson-Henry also raised the same hybrid in the same manner. Again, shortly after Messrs Veitch raised their greenhouse hybrid Rhododendron "Princess Royal" (*R. jasminiflorum-javanicum*), a plant nearly if not quite identical was raised by Mr W. Wentworth Buller. Mr Marshall exhibited a hybrid Begonia (*B. Marshallii*) at South Kensington a year or two ago; and at the same time Mr Dominy had a hybrid (*B. Dominiana*) to all appearance exactly like it, this last being raised between *B. rex* and *B. argentea*. When we see hundreds of seedlings precisely alike spring from the seed-pods of two distinct species, crossed reciprocally, as was the case with *Cypripedium Sedeni* (*C. longifolio-Schlimii*), we have ample proof that hybridising is not altogether mere chance work, and the seedlings of *C Harrisianum* (*C. barbato villosum*), although variable, were not more so than many species, and are themselves equally fertile, but it is only by carefully collating a much larger number of facts than we now possess that we shall be able to catch a glimpse of the laws which regulate hybrid productions A series of experiments, repeated time after time with the same parent species, would do much to clear up the doubts which now exist as to the possibility of reproducing hybrids by again crossing the parent species. The facts above cited go to prove that, in some cases at least, this can be done with tolerable precision. It is, of course, essential in experiments of the kind here suggested, that the plants operated on be in the most perfect health; and the heat, moisture, and other conditions by which the parent species are surrounded when fertilisation is effected should be carefully noted, and as nearly as possible secured when fertilisation is again repeated. It would be very interesting to take three or four healthy blooming plants of *Fuchsia spectabilis* as seed-bearers, and cross these with pollen from *F. serratifolia*, and after sowing the seeds thus produced, note the result, which, according to precedent, should be three or four batches of *F. Dominiana*. This experiment might be tried in the case of any plants of which

the hybrid parentage is known; and in many cases I am fully convinced, from experiments of my own, that, if the same parents are crossed as at first, the reproduction of hybrids would be the result. At present the raisers of hybrids never, or at all events very rarely, attempt to repeat any cross they have previously made, since, if the results are bad, they avoid repeating the experiment, and if it is successful, and a distinct and beautiful hybrid is obtained, reproduction is more easily effected by the vegetative methods, such as cuttings, layers, grafting, or division.

The ends to be obtained by intelligent culture, selection, and cross-breeding or hybridising, may be summed up in the words of the late Dr Lindley as follows: "To increase the size of flowers, or to improve their colour; to approximate their form to some assumed standard of perfection; to enlarge the foliage, as in esculents; to render tender plants hardy; to make barren races fertile; to improve flavour, by changing acidity or austerity into sugary matter; or to exchange early for late varieties." These results have already been obtained, and the further we advance in this noble field of intelligent research and improvement, the fainter do its boundary-lines appear.

Proportionate Results of Cross-Breeding.—The proportionate results obtained by cross-breeding florists' flowers are interesting, and are thus stated in the 'Gardeners' Magazine:' "Mr Keynes of Salisbury sows every year, and has done for many years past, 30,000 Dahlia seeds, and has averaged about ten named flowers for the last twenty years or more—a small percentage, equal to one-thirtieth per cent: in this case, however, it would seem as if many good flowers must be lost, for 30,000 seedlings ought to give at least thirty varieties worth naming, or say one-tenth per cent. The late Mr John Salter estimated that seedling Chrysanthemums worth naming averaged one in every 2000 plants, or one-twentieth per cent. Mr Downie grows 500 Pentstemons or Phloxes to get ten first-rate novelties, this being at the high rate of two per cent. In the raising of plants that admit of careful manipulation, the rate is still higher—the result, no doubt, of the control the raiser exercises. In the case of Dahlias, Hollyhocks, and Chrysanthemums, the raiser has not much control, but he selects the seed parent and watches over the growth of the seed, which is under control to some extent. There are cases in which the cross-breeder goes direct to his work, and having in his mind's eye exactly what he wants, insures it right off; but this is not an everyday business."

Cultural Variability.—Doubtless much is attributed to hybridism, which is really cultural variability; and in drawing attention to some phases of the latter, I cannot do better than quote what Professor M. J. Decaisne * says on this subject: "We cannot possibly doubt but that culture has a great tendency to cause, or at least hasten, the variability of plants, and this doubtless from the complexity of the elements which it brings into action. Changes or transformations which plants undergo in our gardens are much more rapid, comparatively speaking, than the variability of plants in the wild state. For example, the Poppy, the Cornflower, the Larkspur, are always very uniform in habit, and especially in colour, in the wild state; but in the richer soil of our gardens they are modified or changed in the most remarkable manner. Poppy-flowers pass from scarlet to white, or nearly black, by the extension of the basal spot on each petal: sometimes they are shaded with two or more colours, or the crimped edges of the petals become elegantly fringed, while at other times they become perfectly double. Cornflowers and Larkspurs, the flowers of which are so uniformly blue in the wild state, nearly always change their colours, and that shortly after they are introduced to cultivation, and become white or rose-coloured; or rose blends with blue, and causes the bright metallic shades of bronzy purple so common to Larkspurs or Delphiniums: indeed it is very rare that they preserve their primitive colour. We cannot attribute these variations to crossing with other species, since the flowers are fecundated by their own pollen some time before the expansion of the petals; and besides, these variations eventually become hereditary, like the specific characters. Inherence of forms is then not the exclusive right of species, since varieties or races of known origin also possess it in an equal or even superior degree, so that permanence of character—that is, habit, form, colour, &c.—is not an absolute criterion by which to decide that any particular form allied to some other, discovered in a wild state, and recognised as hereditary, is on that account a different species."

It has frequently been pointed out that in a state of nature plant-life is as a rule in a condition of repose, the hereditary firmness of character being sufficient to counterbalance natural disturbing influences; hence the species reproduces itself from seed, and remains in its pure or characteristic state. This balance is so nicely adjusted, however, that if we vary the surrounding conditions of the plant by bringing it into

* See Annales des Sciences Naturelles (1864), 4 série, vol. xx. p. 188, or Journal of the Royal Horticultural Society (new series), vol. i. p. 39.

cultivation, the plant becomes changed, and its offspring are likely to vary. Culture is one disturbing influence; but cultivators avail themselves of even more violent measures in conjunction with it, one of the most potent of these being hybridisation. That plants are changed and ameliorated by culture has been known from the beginning of man's history; indeed, culture is especially used as a means of increasing crops, or with the definite object of changing them in size, form, texture, flavour, and value, either as necessaries or luxuries.

Wichura has the following remarks on the subject of cultural variability: "Transported from nature into the garden, or from a warm into a colder climate, the plant preserves its peculiarities for a time; then slight changes creep in, and more follow, until ultimately, by repeated generation, scarcely one seedling individual is like another. In this state the pollen of many plants resembles that of hybrids in its variability of form, structure, and even chemical composition. Most cultivated varieties of *Primula auricula*, *Hyacinthus orientalis*, *Tulipa gesneriana*, *Solanum tuberosum*, *Brassica oleracea*, *Mathiola incana*, *Antirrhinum majus*, *Cineraria cruenta*, and Verbenas, have strikingly irregular pollen. Kœlreuter therefore says rightly that the nature of species of plants and beasts is to a certain extent like that of hybrids as soon as they are in any way removed from their natural conditions. Where culture and hybridising or cross-breeding concur, the consequences of disaccommodation are naturally quicker and more extensive or variable than where only one of these agencies is at work. Thus we find in fancy and show Pelargoniums, giant Pansies, Calceolarias, Fuchsias, Strawberries, and many other artificial or hybrid races, variability and multiformity of pollen in the highest degree. It is probable, although not proven, that in cultivated plants—that is, species as in hybrids—irregularity of pollen favours variability. If gardeners, in raising new fruits or flowers, varieties or hybrids, would use the microscope or a good lens, and allow those individuals to remain for seed which have the most irregular pollen, or if they would use the most irregular pollen in artificial fertilisation, they would doubtless materially facilitate the accomplishment of their desires. The imperfection of pollen in hybrids is often adduced as a decidedly distinctive mark between them and pure species; but the fact is, there are hybrids the pollen of which is little less regular than that of the parents—as, for example, in Petunias; and there are pure species, or wild plants regarded as such, which have more irregular pollen than many known hybrids. Yet, generally speaking, it is quite true that hybrids generally have

more irregular pollen than species. Gaertner remarks that the anthers of all fertile hybrids, as *Nicotiana rustica-paniculata*, *Malva mauritiana-sylvestris*, *Aquilegia atropurpurea-canadensis*, *Lychnis diurna-vespertina*, have larger and smaller pollen-grains mixed in different proportions, beside small grains of very variable size and form, some curiously elongated, some shrivelled, others mere dry sacs, the latter form being especially the case with the less fertile hybrids—a fact also observed by Kœlreuter, who observes that the increased luxuriance of many hybrids arises from the fact that they are sterile, the weakness or impotence of the generative organs in luxuriant hybrids inducing an increase of vegetative growth.

"Sometimes nature produces offspring of extraordinary proportions from parents of ordinary characteristics. How this happens—whether from peculiar temperature and high cultivation causing redundant vigour and power at the time of fecundation, or from what other cause—we are not yet able to determine. An instance of this kind is to be seen in the *Camellia Floyii*, an American seedling whose gigantic habit, and large and thick foliage, are without a parallel in the whole tribe; and what renders this the more remarkable is the fact that when this variety was raised from seed by Mr Floy about sixty years since, there were not ten varieties of the Camellia in the United States, to none of which have we been able to trace its genitive origin. From a cross by this Camellia was produced Camellia President Clarke, which inherits many characteristics of the parent. In fruits we find the same augmentation in the size of progeny from parents of common size. Beurré Clairgeau Pear, so large and beautiful, is without doubt from the seed of Beurré Capiaumont; the Northern Spy Apple, so magnificent in proportions and beauty, from the Red Nonsuch or old Canada Red. Both these seedlings are of unusual vigour and beauty, and from whatever impregnation they may have arisen, they furnish evidence of the power of nature sometimes to produce without the aid of man varieties of great excellence."—(See Marshall P. Wilder's Address to the Massachusetts Horticultural Society, Feb. 7, 1872.)

Bud Variation or Sports.—As we have already observed, hybrid plants, or the seminal offspring of two distinct—that is, different—species as parents, are practical truths or facts; and in many cases, were their hybrid origin unknown, no botanist would hesitate to describe them as new species. Indeed this has already been done in one or two cases, and notably in the case of *Imantophyllum cyrtanthiflorum*. Not that the botanist is to be blamed for these little oversights, he having in many

cases no information beyond that afforded by an examination of the plant before him, and it is impossible to find any definite distinction between hybrids and species, even after the closest examination possible; and many hybrid plants, such as *Delphinium formosum*, *Primula elatior*, and others, reproduce themselves from seed as exactly as, or even more so than, many pure species or plants generally received as such. Indeed some varieties, and notably *Pelargonium* "*Christine*" and *P.* "*Madame Vaucher*," and the races of Greengages and Damsons among Plums, reproduce themselves from seed with but little variation. Just as species and varieties are in many cases undistinguishable by structural or functional characteristics, so are bud variations or "sports" often so permanent and distinct as to be perfectly unrecognisable from seminal varieties; indeed it is often assumed that sports and seminal variations have a common causation in the uniting of two sets of individual characteristics by hybridisation or cross-breeding, only in the latter case the variation is apparent from the time of the germination of the seed, while in the former the blended characters are not apparent until after the plant has grown considerably.

In the 'Proceedings of the Royal Society,' 1872, Mr Francis Galton has a valuable paper on "Blood Relationship," from which we learn that every individual parent animal (and we may add plant) transmits, or has the power to transmit, to its progeny qualities and variations which are latent in itself, but which may become apparent in the offspring from the first; or, owing to some cause of which we are unaware, these latent and previously unsuspected qualities break out in the individual in the form of sports. Thus every adult human being and every perfect plant is composed of two sets of characters, the one apparent, the other latent; and both of these are combined in the primary stage, having been inherited, and they are both again combined in the progeny. There are, however, two parents, and what is true of the male is true also of the female; and it is thus made evident that the primary or germinal vesicle stage, although apparently a simple one, is really more complicated than the adult or perfect form, for in the germinal vesicle and embryo are condensed the united latent and personal or evident characters of both parents. The multiplication of characteristics in individuals would thus go on in progression, were it not that the weaker characteristics are crowded out or rendered latent by the stronger ones in all well-organised progeny.

The physiologist is as uncertain as the practical cultivator as to the causation or origin of these variations: they are never-

theless facts—often very beautiful facts—and not unfrequently the florist welcomes them, and increases them by grafting or budding, well knowing that if distinct, as is frequently the case, they are facts worth gold. Many varieties of Roses, Camellias, Chrysanthemums, bronze and tricolor Pelargoniums, Bouvardias, Azaleas, &c., have originated in this manner, and have been at once seized and turned to good account by the intelligent cultivator. In the case of cultural or cross-bred varieties, this variability may be partly owing to culture or nutrition, but whole or partial reversion to pre-existing types offers another source of explanation. The theory of pangenesis as advanced by Darwin shows pretty plainly how this may take place: a trace of colour or hereditary taint may linger from generation to generation without showing itself, and then, owing to some cause of which we know nothing, some interruption to the smoothness and sameness of plant-life takes place, and the result is variation in habit, form, colour, or precocity. The theory of reversion is feasible enough wherever varieties are concerned; but when we remember cases of species which sport—take for example the Chestnut near Geneva, cited by Decandolle, one branch only of which bears double flowers—no theory of reversion to pre-existing types, or pangenesis, will go far towards explaining this singular phenomenon. Mr Henderson, a distinguished American horticulturist, remarks that in a bed of about one hundred cuttings of the new Tea Rose, "La Nankin," all made from one parent plant, he found four distinct varieties, some with clear nankeen flowers, others pure white, others light pink or blush, and the remainder in the normal state, white above and nankeen below. Mr T. A. Knight mentions a case where a tree of the yellow Magnum Bonum Plum, 40 years old, suddenly produced red fruit on one branch; and he had a Mayduke Cherry in his garden, one branch of which annually bore oblong, heavier, and later fruit than the rest of the tree, but of inferior flavour.—(See Trans. Hort. Soc., vol. ii. p. 160.) There is no practical and very slight theoretical difference between a bud variation, *i.e.*, sport, and a seedling variety, since both may be perpetuated, if desirable, either by cuttings, layers, or by grafting; and in this way many weeping, fastigiate, cut-leaved, and other ornamental trees have been obtained, to say nothing of all the many variegated plants which add so much variety to our own gardens as well as to those of China and Japan.*

* Those who wish to pursue this subject further should read Dr M. T. Masters's valuable paper on "Bud Variation" in 'Gard. Chron.,' 1872, p. 1388, 1453, and 1523. The papers of Naudin, Braun ("Rejuvenes-

Diœcious and Monœcious Plants.—Wichura observes—and, as I think, very rightly—that diœcious plants which are subjected to fertilisation by insects must necessarily produce hybrids, and especially so if they comprise a great number of species nearly related, growing in close company, and all flowering at the same time. In cultivation, however, all diœcious plants do not flower synchronously, and this is especially the case with the male and female Aucuba, and with the monœcious Nepenthes and Crotons. M. Carrière, in relating his experience with seedling male and female Aucubas in the 'Revue Horticole,' says that out of several thousand seedlings which he has raised, those which have flowered are, with few exceptions, male plants, and that the few female plants which did appear have flowered much later than the male seedlings—that is, several weeks, and sometimes even two or three months. *Cœlebogyne ilicifolia*, a plant long thought to develop female organs only, has at length been found to produce male organs simultaneously with the female ones. Diœcious grasses, Palms, and other plants rarely produce fertile seeds in cultivation, owing to the male plant being absent, or on account of their not being in bloom at the same time. Where the male plant blooms earliest, pollen may in most cases be preserved by wrapping it in dry tinfoil or silk-paper; and all hybridisers would add greatly to our knowledge by recording the length of time they have kept pollen in its potent state. In case a female plant blooms, and it is of importance that its flowers should be fertilised, fresh pollen may in many cases be procured by advertisement, or from correspondents abroad or plant-loving friends at home.

Many hermaphrodite plants are for all practical purposes monœcious—that is, contrivances have become developed to prevent self-fertilisation, or their male and female organs

cence Cytisus Adami"), and Duchartre, "Note sur le Chasselas Panaché," in the 'Journal de la Sociétie Impériale et Centrale d'Horticulture,' 1865, should also be consulted in connection with Dr Masters's paper. Dr Masters contributes a valuable and interesting paper "On a Pink Sport from Gloire de Dijon Rose" to the 'Journal of the Royal Horticultural Society,' vol. iv. p. 153, which should be read by all interested in this subject. See also Carrière, 'Production et Fixation des Variétiés dans les Végétaux,' p. 35; Darwin, 'Variation of Animals and Plants,' 1868, p. 379; article on "Bud Variation," 'Popular Science Review,' 1872; and "Graft Hybridisation," 'Popular Science Review,' 1871, p. 141. Carrière gives a list of Roses which have originated from sports, and Darwin gives copious references to the literature on variability among plants. See also 'Gardeners' Chronicle,' 1871, p. 74, and Herbert's 'Amaryllidaceæ,' p. 377.

assume an alternate development which secures the same end.

Cross-Fertilisation and Fertility.—Some experiments made by Mr Williams go to prove that artificial fertilisation not only improves the quality, but also increases the quantity of the seed produced. For example, a flower of *Victoria Regia* fertilised with pollen from another flower growing on the same plant yielded four times as much seed as when left to become naturally fertilised, and above one-half more than when carefully fertilised with pollen from the same flower; and the result was still better by two-thirds when the flower was fecundated with pollen from a flower of the same species growing on another individual plant.

1.	2.	3.	4.
Produce of naturally fertilised flower.	Produce of flower fertilised with its own pollen artificially.	Produce of flower artificially fertilised with pollen from a separate flower grown upon the same plant	Produce of flower fertilised with pollen from a different plant of the same species.
25 seeds.	60 seeds.	100 seeds.	300 seeds.

Dean Herbert, writing in 1837 (see Herb. Am., p. 371), remarks: "I am inclined to think that I have derived advantage from impregnating the flower from which I wished to obtain seed with pollen from another individual of the same variety, or at least from another flower rather than with its own, . . . and especially from an individual grown in a different soil or aspect." To illustrate this, he mentions that he had nine hybrid *Hippeastra* flowering in his stove, and being desirous of blending these still further, the different flowers (stigmas) were touched with pollen from their several neighbours and ticketed, other flowers being touched with their own pollen. Almost every flower that was touched with pollen from another cross produced seed abundantly, and those which were touched with their own pollen either failed entirely or formed slowly a pod of inferior size, and with abortive flower-seeds. "It seems to me that this circumstance may be analogous to the introduction of a male from another flock or herd, which has been found advantageous to the breed of domestic animals."

Hybrids prove that their parents are nearly-related species,

or have descended from a common origin, and in their entire system of growth are quite as normal and often as fertile as well-authenticated species. Sterile hybrids—that is, mules which are incapable of bearing fertile seeds when fertilised with pollen from a nearly-related species—are very rare; and some of those which are reputed sterile produce fertile pollen, which may be used to fertilise other species or varieties. *Forsythia viridissima*, which rarely produces seed from its own pollen, fruits freely when fecundated with that of *F. suspensa;* while the common garden Balsams require cross-fertilisation in order to secure a prolific supply of fertile seeds.

M. Nägeli has pointed out that conditions of sexual vigour, or even absolute sterility, are no proof of hybridity, since many individual plants of direct descent are sometimes sterile; indeed the whole question of fertility seems to hinge on constitutional vigour and a proper supply of nutriment. While many hybrids seem to have weakened reproductive powers, crosses between different species of Calceolaria, Erica, Dianthus, and Pisum are more fertile than the original species from which they have descended; so that we also in some cases obtain additional sexual vigour or fertility in hybrids and their subsequent progeny, notwithstanding that sterility and additional vegetative vigour or growth is in many cases the rule.

The late Professor Henslow wrote a most valuable treatise on one of the hybrid Foxgloves (*Digitalis*), with a view to discover, if possible, the distinction between species and hybrids. In this object, however, he failed, not from want of accuracy, but simply because no such difference exists.

Immediate Effects of Foreign Pollen.—It is generally supposed that the effect of crossing or hybridising is confined to the embryo of the seed which has been vivified or quickened by foreign pollen; but there are at least two or three well-authenticated cases in which the impression or influence of the strange pollen has immediately altered the fruit or seed in general appearance.

Some interesting experiments bearing on the influence of strange pollen on the form of fruit have been made by Maximowicz.—(See Jour. Royal Hort. Soc., vol. iii. (new series), p. 161 *et seq.*) The species experimented on were *Lilium davuricum* and *Lilium bulbiferum*. The pollen of each species was applied to the stigmas of the other species, the process being repeated upon several individual plants. The result was that the capsules borne by the several plants were found to have the form characteristic of the pollen parent; while the form of

the seeds was intermediate between that of those of the two parents.* Another instance is quoted from a French pamphlet in the 'Journal of the Royal Horticultural Society of London' (new series, 1866), vol. i. p. 51, from which it appears that one of the objects with French wine-growers is to obtain Grape-juice of a deep colour; and a Grape named Le Teinturier is remarkable as having coloured juice, but is not a prolific bearer. 'The idea of crossing this variety with Aramon and other prolific wine Grapes having pale juice occurred to M. Bouschet, and he succeeded in raising a race of Grapes with coloured juice; but a more important result from a scientific point of view was obtained from these experimental attempts. The berries of the pale-juiced varieties fertilised with pollen from Le Teinturier yielded coloured juice the first year, while others on the same bunch (but unfertilised by that variety) retained their original character. Yet another case, but this time a rather doubtful one, occurred in Mr J. Watson's nursery at St Albans, where a Cucumber plant bore a globular fruit, exactly like a Melon in form, together with normal Cucumbers. This is figured and described in the 'Gardeners' Chronicle,' October 4th, 1873, p. 1335, and is supposed to have been brought about by the accidental fertilisation of a Cucumber flower by pollen from some Little Heath Melons growing in close proximity in the same house. At a meeting of the Academy of Natural Sciences at Philadelphia, Mr Thos. Meehan made the following highly interesting and important observation: "Mr Arnold, Paris, Canada, determined to observe the effect of cross-fertilisation on Indian Corn (*Zea mays*), and to this end he procured a brown variety, with a circular dent on the apex, and from this he raised one plant. The first sets of flowers were permitted to be fertilised with their own pollen, in order to test whether there was any reversionary tendency in the plant or the pollen of any other variety in the vicinity. The ear which Mr Meehan laid on the table was the result, every grain being like its parents. The Corn or Maize plant produces two ears on each stalk. As soon as the 'silk' pistils of the second ear appeared, the pollen, in a 'tassel' of the common yellow Flint Corn (a well-known American variety with yellow grains) was procured, and set in a bottle of water,

* It is quite possible, and indeed highly probable, that Maximowicz has here attributed to the action of foreign pollen a result which is due to specific variation. Nearly all Lilies are very variable in habit, and but little reliance can be placed on the form of any fruits, unless grown and compared in large quantities. Professor Dyer has, moreover, pointed out that *L. bulbiferum* in the Kew Herbarium bears fruit like that of *L. dauricum*, as described by the Russian botanist.

tied near the developing ear, the plant's own 'tassel' (anthers) having been cut away some time previous. After sufficient time had elapsed, this set of male flowers was removed, and a panicle of male flowers from a white-grained variety was introduced to the same bottle, in order to afford the pollen an opportunity of operating on the same female flowers, and the result was another ear (cob), which Mr Meehan exhibited, and the corn in this head was variegated, the base of each grain being of the yellow Flint Corn, while the upper half was of the white variety. From this curious and valuable fact Mr Meehan came to the conclusion not only that there was an immediate action or influence on the seed and the whole fruit structure by the application of strange pollen, but the still more important fact, hardly before more than suspected—namely, that one ovule could receive and be affected by the pollen of two distinct parents, and this, too, after some little time had elapsed between the first and second impregnation."

The known cases where the immediate action of foreign pollen on the fruit has been noted are so concisely given in Professor Dyer's translation of Maximowicz's paper cited above, that I gladly avail myself of the following quotation, which summarises the whole matter—with references to the original papers :—

"The few instances may be found collected in Gaertner* or Darwin.† Thus Mauz asserts that he observed different kinds of fruit on a Pear-tree, of which a number of blossoms had been castrated, and, as he supposed, fertilised afterwards by neighbouring trees.‡

"Pavis maintained that the fruit of Apples, Melons,§ and Maize underwent alteration in form, colour, and special qualities when they were planted near other kinds.‖ Bradley even says that he had seen an Apple which was sweet on one side and sour on the other, and one half of which became soft

* Die Bastardzeugung, p. 73.

† Animals and Plants under Domestication, i. 397.

‡ See Gard. Chron., 1871, p. 1354.

§ [Livingstone states (and the instance has not, I think, been quoted) that in the case of *Citrullus vulgaris*, Schrad., which varies with sweet and bitter fruit, "Melons in a garden may be made bitter by a few bitter Kengwe in the vicinity. The bees convey the pollen from one to the other"—(Travels in S. Africa, p. 49).—Tr.]

‖ Dr Hogg mentioned at a meeting of the Royal Horticultural Society, Dec. 15, 1868, a case where Pear Beurré Superfin and Doyenne Depais were growing close together on a wall, and the last-named variety bore a fruit exactly like the former, the inference being that the flower which produced it had been accidentally cross-fertilised with pollen from flowers of Beurré Superfin.

when boiled, while the other remained hard. But these are only observations, and not experimental results. Wiegmann first obtained the latter in Peas. Gaertner tested experimentally many of the statements which we have quoted, and made experiments on other plants besides. He was only able, however, to confirm Wiegmann's results to a certain extent. He is therefore disposed (and with much reason) to attribute the majority of such cases to variation in the individual; he allows, however, as a rare exception, the possibility of change even in the mother plant itself. Other observers (as, for example, Knight,* and recently even Nägeli †) deny even the possibility of such an influence.

"More recently Darwin has again quoted cases‡ where, by crossing yellow and dark Maize, cobs were produced which contained both yellow and dark grains. Hildebrand § confirms these observations, and further cites the instance of an Apple which bore traces in its marking of the influence of another sort. But whilst the question has been in these cases only a variation in the colour, in the three which follow we find it affecting the form. Hartsen‖ has seen on *Solanum edule* (the well known Egg plant) a fruit which in colour, size, and shape exactly resembled a Tomato, and possessed only the greater dryness and firmness of the flesh of the Egg fruit, besides the smooth border of the seed, which in the Tomato is villous. Dr Kanitz ¶ met with a case of a hybrid fruit, between *Lycopersicum esculentum* and *Capsicum annuum*. Fritz Muller** fertilised *Cattleya Leopoldi* by *Epidendrum cinnabarinum*, and obtained seeds of the former with the shape belonging to the latter. Meehan,†† lastly, observed that the bough of a Pear-tree, which had always been altogether unfruitful, projected into the boughs of a neighbouring Apple-tree. Fruits were produced, which in skin, flesh, and other respects were altogether Apples, and had only the seeds, carpellary partitions, and stalk of the Pear.

"These are all the cases with which I am acquainted. Considering, then, that the observations of Bradley, which are the earliest, date from the year 1721, and that the list has only increased very slowly, notwithstanding the vast opportunities for noticing these cases which botanists and gardeners have had in crossing different species of plants, we must allow that Gaert-

* Trans. Royal Hort. Soc., v. 67.
† Sitzungsberichte d. bayerischen Akad., cited by Hildebrand.
‡ Savi, cited by Darwin, *l. c.* p. 400.
§ Bot. Zeit., 1868, p. 325, t. 6. ‖ Bot. Zeit., 1867, p. 378.
¶ Bot. Zeit., 1867, p. 335. ** Bot. Zeit., 1868, p. 631.
†† Proc. Acad. Nat. Sc. Phil., 1871, vol. i.

ner was quite justified in declaring that the immediate influence of foreign pollen upon the mother plant is a rare exception.

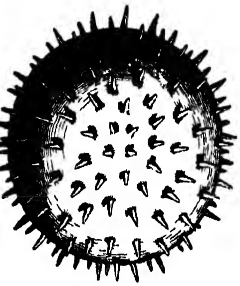
"If we agree with Gaertner in excluding from the list, as possibly due only to bud variation, those cases which are not the result of direct experiment, the only well-established ones which remain are those of Maize,* Peas, and *Cattleya Leopoldi.*"

In the 'Book of the Garden,' vol. ii. p. 321, Mr Anderson-Henry records the interesting fact that he "once spoiled a pure *white*-bloomed Calceolaria for exhibition, by crossing it with a *crimson* sort; all the blooms on those branches where the operation had been performed being stained *red*, and not the few flowers merely which had been actually crossed." It is undoubted that cross-fertilisation effects a change in the embryo apart from mere fertilisation; and the above facts go to prove that changes effected by foreign pollen are not unfrequently evident.

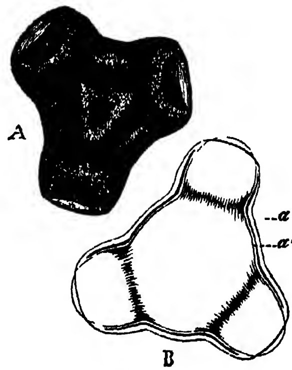
Preservation of Pollen.—The natural contrivances for the due preservation of pollen are so varied and interesting, that we must briefly allude to them ere entering on the more practical part of our subject. In the proceedings of the "Scientific Society of Innsbrück," Dr A. Kerner has a valuable memoir on different modifications of structure which flowers have assumed, evidently for the purpose of protecting the pollen from injury. Pollen is of two kinds, powdery and coherent. The former kind is found almost exclusively in those plants whose fertilisation is effected by the agency of the wind. The quantity of pollen is in these cases enormous; the anthers are frequently attached very slightly to the end of elongated filaments, so that the pollen is shaken out of them by the least breath of wind; the flowers grow on the most exposed parts of the plants, frequently appearing before the leaves, so as to give greater facility for the dispersion of the pollen, and are not provided with brightly-coloured corolla, powerful scent, or nectar, for the purpose of attracting insects. Plants, on the other hand, whose pollen is coherent, are dependent on insect agency for its dispersion and transport to the stigma. It is therefore absolutely essential in these cases that some means should be provided for its protection from moisture, whether rain or dew, which would immediately destroy its efficacy, until such time as it may be carried away by insects. A variety

* See Trans. Royal Hort. Soc., vol. v. p. 234, for detailed account of change of colour in the garden Pea by cross-fertilisation, with coloured plate. In same vol., p. 63, is a most interesting paper on this subject, with reference to analogous cases.

of contrivances is actually found in nature for effecting this end, which may be classified under the following heads: 1. Protection by portions of the pistil or stamens themselves, as in many Orchids, Aristolochias, Asclepiads, and the petaloid stigmas of Iris. In the flowers of *Lecythis* (Monkey-pots), part of the stamens are fused together into a unilateral cucullate body, which forms a roof or umbrella over the perfectly-developed anthers and style (see Lindl., Veg. King., p. 739). 2. By portions of the calyx and corolla; this occurs in an immense variety of forms. 3. By sheaths, bracts, or foliage-leaves. 4. By periodic movements of the leaves of the perianth, as in the closing of flowers at night or in rainy weather. 5. By curvature of the axis, as in those numerous flowers the



An "echinated" or "spine covered" pollen-grain of a species of Tree Mallow (Lavatera trimestris, L.), mag. 200 times.

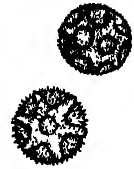


Pollen of Clarkia elegans, Dougl. A, Seen a dry object. B, Seen in water; a a' The two layers of extine (mag. 200 times).

opening of which is always turned towards the ground at the period when fertilisation takes place. From the examples adduced, Kerner draws the general conclusion that the protection of the pollen against the injurious effect of premature moisture is the more perfect the smaller the number of flowers and of pollen-grains in the individual, the greater their degree of coherence, and the more exclusively the flower is fertilised by insect agency. In those plants where the flowering extends over a great space of time, where the anthers in the same flower vary in the period of their dehiscence to allow the escape of the pollen, and where the number of flowers in an inflorescence is very large, the protection of the pollen against the influence of the weather is reduced to a minimum, as in

Umbelliferæ and many species of Cruciferæ and Saxifraga. Finally, Kerner draws the conclusion that those plants whose coherent pollen renders insect agency necessary for their fertilisation can only have existed in very recent geological periods; and those new species or varieties must necessarily have the advantage, and tend to become perpetuated, which possess superior advantages, in respect to the climate in which

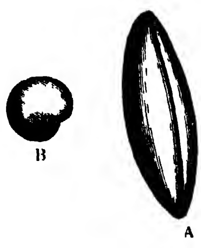
Pollen grain of Fumitory (Fumaria officinalis, L), showing four of the great pores on it (mag. 200 times)



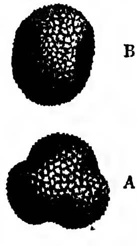
Pollen-grain of Chicory (Cichorium Intybus) seen on two different sides (mag. 200 times)

they grow, for the protection of their pollen from all injurious influences. The plants, the remains of which are found in the oldest geological formations, are generally of that class which do not require insect agency for their fertilisation.

Practically, it is often highly necessary to preserve pollen from early-blooming plants with which to fertilise later-bloom-



Pollen of the Tiger Lily (Lilium tigrinum, Gawl.) with a "slit." A, Viewed in front; B, Viewed at one extremity (mag. 200 times).



A pollen-grain of Pelargonium zonale, W., viewed in two different aspects to show its form. A, Side view; B, Its extremity (mag. 200 times)

ing species or varieties, or *vice versa*, as the case may be. In the case of some diœcious plants, which do not flower simultaneously, this is absolutely necessary, the common Aucuba being a familiar example. By forcing late-blooming species and forms, and by retarding earlier ones, we may succeed in obtaining pollen at the precise moment when it is required; but it is a most important fact for all hybridisers to know, that

pollen carefully shaken from the anthers during dry sunny weather when perfectly ripe, and wrapped neatly in silk-paper, will retain its quickening or vivifying powers for days, weeks, or even months together. Silk-paper or tinfoil is the most convenient covering in which to preserve pollen-grains; but if it is to be kept for a great length of time, it should be hermetically sealed in glass tubes, which can be bought at any chemist's. One end of the tube is sealed by holding it near a gas jet, and using a blow-pipe to intensify the power of the jet. After the end is sealed, allow it to cool before the pollen is enclosed, then shake it down to the sealed end, and seal the other end in like manner. If you are not familiar with the use of the blow-pipe, seal the ends of the tubes with hot sealing-wax. Pollen may be mounted in dry cells, and covered by a strip of thin glass, as used by microscopists, air being excluded by Canada balsam—and so treated, retains its vitality; and there is the additional advantage that it can be often examined under a low power, and any change noted. On no account must the pollen have been wetted before it is enclosed, for on its being gathered in a dry and fully-developed condition depends its keeping qualities and quickening action. As yet we know but little as to the comparative vitality of either seeds or pollen, and experiments with pollen are especially to be desired. The late Dean Herbert, in alluding to this subject nearly forty years ago, remarked that "old pollen which has been kept perfectly dry may act so as to fertilise, but that which has once been damp cannot do so." The pollen of *Cereus grandiflorus*, kept for six weeks in a bit of paper, enabled Mr H. Brown to obtain a hybrid between that species and *Phyllocactus Jenkinsonii.* Linnæus found that the pollen of *Jatropha urens*, six weeks old, was but little impaired in its action.

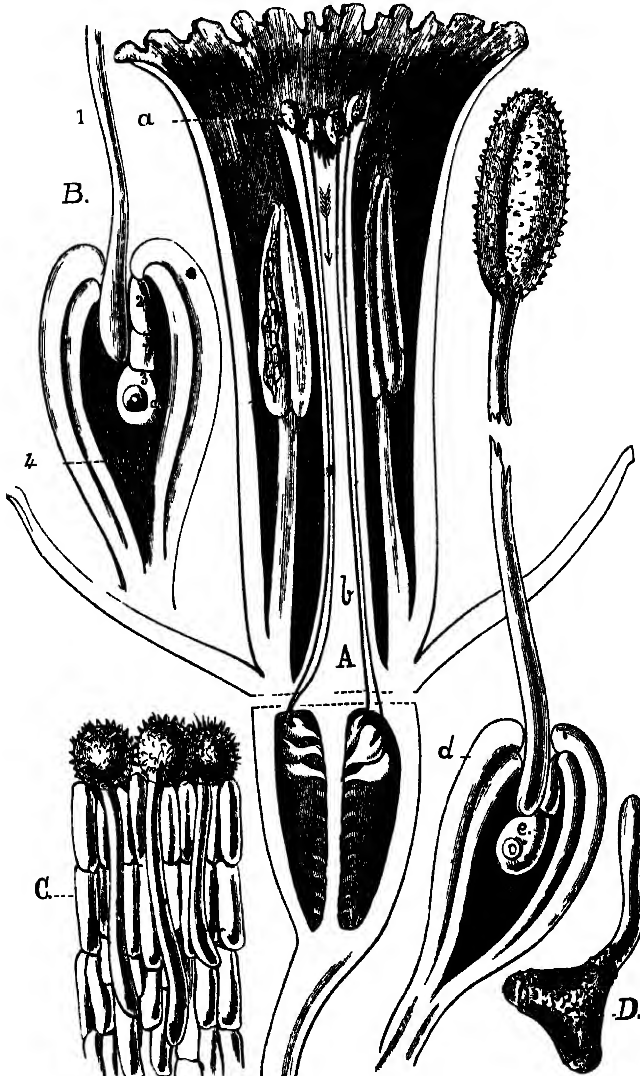
Wichura (see Jour. Royal Hort. Soc., 1866, vol. i. p. 58), in speaking of the pollen of Willows (*Salix*), remarks that fresh pollen, placed in a weak solution of honey and water, began to emit pollen-tubes in the course of ten or twelve minutes. Pollen of *Salix silesiaca*, eight days old, seemed almost as potent as ever, but in twenty-eight days the traces of vitality were very slight; while that of *S. cinerea* had become weak in sixteen days. On the whole, it seems that pollen of Willows, if kept in a dry, cool, shady place, is efficient when fourteen days old, and it may be implicitly trusted at eight days old. Mr Anderson-Henry observes that the pollen of Rhododendrons is potent after being kept for six or eight weeks, and pollen of *Clematis Jackmanii* was found to be potent after

being kept eleven months! Pollen for keeping should be cleaned out of the anthers and wrapped in soft paper, and for further security the whole may be enclosed in tinfoil. Carefully separate the pollen from the bits of anthers and filaments, for if these are enclosed with the pollen, they cause damp and mould. M. Lecoq gives the following information on this part of our subject: "The preservation of pollen about to be used in hybridisation will require great care, if brought from a distance. It often happens that the pollen required to fertilise a plant cannot be procured exactly at the time desired; and if it be necessary to keep it for some time without using, the following precautions may be observed: place the collected pollen in the hollow of a watch-glass, and let it remain exposed for a few hours (but not in the sun) till a portion of its moisture has evaporated; another watch-glass of the same size may then be placed over the one containing the pollen, and made air-tight by the application of gum round the edges. As to the length of time during which it may be thus preserved, nothing precise is known, except that the pollen of some kinds of plants will keep much better than that of others. M. Haguin, of Liege, has fertilised Lilies with pollen that had been collected for more than forty-eight days—Azaleas, with pollen forty-two days old; while Camellias respond to the fertilisation of pollen that has been kept for sixty-five days. These periods are far exceeded by that of the retentive powers of the pollen of *Ceratozamia mexicana* (see Cycadaceæ), which, after being preserved from 1866 to 1873, was successfully applied by M. Houllet, chief of the plant-houses of the Jardin des Plantes. Nevertheless, M. Bleu, well known as the producer of a noble series of hybrid Caladiums, states his full conviction that the freshest pollen is the better. M. Haguin cuts the anthers he requires immediately on the opening of the flower, wraps them carefully in a pasted-up seed-paper, and leaves them in a dry and warm situation for twenty-four hours. By that time the fecundating dust has fully ripened, and M. Haguin then envelops it closely in thin sheet-lead, numbering and naming each kind, and placing them in a dry but cold situation till required for use. M. Perrolet reports from Guadaloupe that the male pollen of a Date Palm (which flowers three months before the female tree) was kept during the three months required without injury."

Emasculating the Flower.—This operation consists in carefully removing the stamens from hermaphrodite flowers before the anther-slits, pores, or folds open to discharge the pollen or admit of its escape. As a rule, this is one of the most import-

ant operations connected with hybridising, since it is next to impossible to fertilise with foreign pollen—*i.e.*, of another species or variety—if the pollen of the same species or form gains access to the stigma. For example, it is useless to expect successful results from crossing *Lilium auratum* with pollen from *L. speciosum*, or pollen of any other species of Lily, unless the six anther-cases of *L. auratum* are carefully cut away before they open, and before the strange pollen is applied to the glutinous stigma. The exceptions to this rule are very few; yet in some Passion-flowers (*Passiflora*) and Breeze-flowers (*Zephyranthus*) the native pollen is impotent, and that of other species, or varieties of other species, prepotent. The only safe rule is to remove the unopened anthers as early as it can well be done—that is, without injuring the essential organs of the flower, more especially the ovary and style. Some flowers, as Ericas, many Papilionaceous or Pea flowers, many Amaryllids, Lilies, Crocus, cereal grasses, composite plants, and many others, require to be cut open when in the bud state. To do this, make a clean slit with the point of a keen penknife, and insert the fine points of a pair of hybridising scissors, or a bit of finely-hooked steel bouquet-wire, and cut or drag out all the anthers, which in many cases requires a deal of patience and skill. The flowers to be operated on should be selected on the freshest and healthiest portion of the plant, those about the middle of the shoot or cluster being generally the best. In some cases, the most forward buds produce the finest flowers, and earliness is an advantage, so as to allow the seeds plenty of light and sun-heat to ripen; and when this is the case, these should be selected, and all the others cut away. The next consideration is to place the plant where there is no chance of pollen of the same species, or indeed any other species in the same genus, obtaining access to the stigmas, either through the agency of the wind or insects. This is much more difficult in practice than it appears at first sight; and one of the surest ways of avoiding accidental fertilisation is to force the seed-bearing and pollen plants, so as to have them in bloom before any other allied species are in flower. In the case of monœcious plants intended for bearing hybridised seed, the male flowers are all removed when in the bud state, and as soon after their sex is visible as possible; while in the case of diœcious plants, all that is necessary is the complete isolation of the female plants from all those which bear male flowers, excepting, of course, the one intended as the male or pollen-bearing parent.

Application of the Pollen.—The act of fertilising the flower is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simple enough in most cases, and consists in transferring the dusty, wax-like, fibrous, or flour-like pollen from the anthers of the male parent to the stigma or stigmatic surface of the female organs. It matters not how the pollen is applied; powdery pollen may be applied with a fine-pointed camel's-hair pencil, or the tip of a feather: and here great care is necessary to cleanse it thoroughly before operating on another plant, as some pollen-grains may linger unseen among the hairs, and become applied unwittingly to another plant. In the case of such Orchids and Asclepiads as have wax-like pollen masses, the point of a quill, toothpick, or other little implement of similar form, may be used to transfer the pollen from the anther-cases to the stigmatic cavity. As a general rule, the stigma is borne at the end of a column, or style, which is fleshy and three-lobed as in Tulip or Lily, slender and fringed at the apex as in many Cacti and in Crocus, forked and set with hairs as in Asters, Marigolds, Sunflowers, and other Composites, or feather-like as in corn-plants and grasses. For all practical purposes of artificial fertilisation the size, shape, or position of the style and the anthers is perfectly immaterial, the point being to place the pollen carefully, and in sufficient quantity, on the stigma just at the time when the pollen is perfectly ripe,—*i.e.*, when it is naturally shed from the anthers, and when the surface of the stigma is receptive—that is, fully developed and covered with a gummy or viscid secretion, the use of which appears to be to retain the pollen when applied, and to favour or promote the emission of the pollen-tubes, by which the quickening connection is established and effected between the pollen-grains, as applied to the viscid or hairy stigma, and the ovules or young seeds. In the January number of 'Microscopical Science,' 1866, is an interesting account of the fecundation of Tigridia by Dr P. Martin Duncan and Dr

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DESCRIPTION OF ILLUSTRATION ON PRECEDING PAGE.

A, *Section of Narcissus flower enlarged, the tube purposely omitted. a, 4 pollen-grains on the stigma. b, Style—the black lines represent the course of the pollen-tubes down the tissues of the style to the ovules or young seeds. c, Pollen-grain and pollen-tube of Narcissus enlarged d, Ovule enlarged; showing the enlarged end of the pollen-tube, which has entered the mouth of the seed in its embryo state so as to discharge its vivifying contents and so fertilise or quicken the germinal vesicle shown in the embryo sac at e.*

B, *Ovule enlarged in section.* 1. *Pollen-tube containing protoplasm or quickening fluid.* 2 *and* 3 *represent cells; the upper,* 2, *forming a suspending body; while the lower,* 3, *becomes the baby plant—the incipient bodies a a, or one of them, becoming the growing-point after fertilisation is effected.* 4. *Starch-grains.*

C, *Pollen-grains of Dahlia emitting their tubes, which are shown passing down the cellular tissues of the style.*

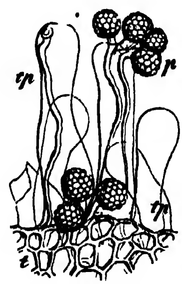
D, *Pollen-grain of Grevillea emitting pollen-tube.*

Allen Maclean, and the result of the experiments made go to prove that, as had previously been surmised by Herbert and others, the fecundating tubes emitted by the pollen are not continuous, but that they grow by the addition of new cells, and in Tigridia are propelled through the tissues of the style at the average rate of one inch in six hours, although the rapidity of its growth and the consequent impregnation of the ovules is dependent on atmospheric influence. In direct sunlight and a humid atmosphere the growth increased to one inch in two hours. In their passage down the style (we are told) they are nourished by the juices of the style-cells, and even by the cells of the ovule itself, when that body is reached. The pollen-tube pushes the embryo-sac before it for a short distance—*i.e.*, indents it without perforation; but after a time the contents pass into the embryo-sac—whether by endosmosis or direct injection we are not told—and an embryo is formed. When we are told that the moist cellular tissues of the style afford nourishment to the pollen-tubes, one naturally wonders how they are nourished in Conifers, where there are no styles. Now what do we find? Why, a drop of clear mucilage exuded from the apex of each ovule, and evidently intended as a special provision to secure fertilisation, and to afford nutriment for the elongating pollen-tubes in the absence of the supply which, in the usual course of things, is afforded by the mucilaginous tissues of the style.—(See Conifers.)

Facilitating the Growth of Pollen.—M. Beer, Curator of the Botanic Gardens at Vienna, mentions that M. Hooibreuk, one of his assistants, has adopted the following process, previously suggested by Gaertner, for successfully facilitating the fertilisation of plants. The stigma of each flower to be operated upon is touched with a camel's-hair pencil dipped in honey, or better still, with honey and the pollen of the plant destined to be the male parent. This process has succeeded admirably in the case of fruit-trees. The use of the honey is doubtless to retain the pollen-grains on the stigma; and according to the evidence of Max Wichura, the moisture facilitates the growth of the fecundating tubes. Honey is supplied naturally in some cases, of which the common Agave and *Hoya carnosa* or "wax-plant" are familiar examples. Propagators can generally obtain honey conveniently and in sufficient quantities from the tubular flowers, as in the case of Fuchsias, Achimenes, and many other plants, and the plan here recommended is worth adopting in the case of Muscat Grapes or early Peaches and Nectarines.

How Fertilisation takes place.—Prof. Bentley, in his 'Manual

of Botany,' p. 778, thus describes how fertilisation is effected: "When the pollen falls upon the stigma (the tissue of which at this period, as well as that forming the conducting tissue of the style and neighbouring parts, secretes a peculiar viscid fluid), its intine protrudes through one or more of the pores or slits of the extine in the form of a delicate tube, which penetrates through the cells of the stigma, by the viscid secretion of which it is nourished. In most plants but one pollen-tube is emitted by each pollen-cell, but the number varies. . . . The pollen-tube continues to elongate by growth at its apex, and passes down through the conducting tissue of the canal of the style, when this exists, or directly into the ovary when it is absent. This growth of the tube was formerly supposed to be due to endosmotic action occurring between the contents of the pollen and the secretion of the stigma and style; but it is now known to be a true growth, which is occasioned by the nourishing viscid secretion which it meets with in its passage through the stigma and style.



Longitudinal section of a fragment of the stigma of Matthiola annua, Sweet (the "ten weeks' stock"), showing some pollen grains, p, which have emitted their tube tp. t Proper tissue of the stigma (after Tulasne) mag. 163

"These tubes are extremely thin. They vary in length according to circumstances, but are frequently many inches; and, as has been shown by Dr Martin Duncan, they are not in all cases continuous tubes, as has been supposed—but in Tigridia and some other monocotyledonous plants they are composed of several elongated cells, which are, doubtless, produced by the ordinary process of cell-division. The time required for the development of these tubes also varies in different pollens; thus sometimes they are developed almost immediately the pollen comes in contact with the stigma, whilst in other cases many hours are required for the purpose. The pollen-tubes also occupy a varying time in traversing the canal of the style—that is, from a few hours to some weeks. When the pollen-tubes have penetrated the stigmatic tissue, the secretion of the latter ceases, and the stigma withers. The upper part of the pollen-tube also withers above as growth takes place below.

"The pollen-tubes, having reached the ovary, are distributed to the placenta or placentas, and then come in contact with the ovule or ovules. One (sometimes two) of these pollen-tubes enters into the micropyle of each of the ovules, and thus

reaches the nucleus and embryo-sac. . . . As soon as the contact of the pollen-tube and embryo-sac is effected, a kind of osmotic action between the contents of the two takes place, the result of which is the development of one, or rarely two, of the germinal vesicles into embryos."

All the actual work of fertilisation is carried forward by the organs and tissues of the female plant and the growth of the male pollen; and the work of the hybridiser is to bring these parts into juxtaposition at the most opportune moment—*i. e.*, when both are in vigorous perfection— and to see that the seed-bearing plant is well nourished at the root, until the seed is perfectly ripe. Dr Denny, in his paper read before the Birmingham Congress (see Gard. Chron., 1872, p. 872, 904) on "The Relative Influence of Parentage in Flowering-plants," remarks: "The visible effects of impregnation are frequently manifested with a rapidity almost equalling that of an electrical phenomenon. I have observed the petals of the Pelargonium, which before impregnation were quite firm, to fall within a few seconds of the application of the pollen to the stigma—a result due, I conclude, either to the immediate diversion of nourishment from the then superfluous part of the flower to the organs of generation, or to the existence in the vegetable kingdom of a power analogous to the nervous in the animal, but of which we are as yet in total ignorance." As a rule, hybridisers trust to one application of pollen; but it is advisable to experiment by applying the pollen to the stigma at different times, so long as it remains in a receptive condition. The stigmas of some flowers, as Poppies, Lilies, Nymphæa, and Gardenias, seem to require a large quantity of pollen to fertilise them properly; while in other flowers the least quantity—a few grains, in fact—once applied seem amply sufficient. Some guide to the amount of pollen required may be obtained by noting the number of seeds produced in the capsules, and by noting the profusion of pollen naturally supplied (as in Poppies) when the number of ovules to be fed is large. If the stigma appears to absorb the pollen readily, and remains moist or receptive as if requiring more, apply pollen again and again at short intervals. On the other hand, it is possible that in some cases the application of too much pollen may lead to the disorganisation of the stigma, and thus defeat the object one has in view: and as the elongation of the pollen-tubes is actually carried on by the growth or addition of cells to their extremities, and as it is now pretty certain that they are sustained and fed by the juices which they absorb from the moist cellular tissues of the style, it follows that if we apply too many pollen-grains to the

stigma, it is analogous to sowing seeds too thickly in a pot of soil—we injure the growth of all by allowing to many the quantity of food required by a few individuals.

Epochs when Fertilisation is possible.—The time at which the stigma or stigmas of the plants to be fertilised become receptive must be carefully studied, especially with reference to the following variations among others:—

1. Flowers which discharge their pollen before the stigma is fully developed or receptive. [In this group the Garden-pea (*Pisum sativum*), many species of Campanula, and many Caryophyllaceous plants, may be named as examples.—(See Agave, Lobelias, and Composites.)]

2. Flowers in which the stigma is receptive before the anthers are developed or the pollen is ripe. [In this group the common Rib-grass (*Plantago lanceolata*), Calceolarias, Grass of Parnassus (*Parnassia palustris*), *Chimonanthus fragrans*, and many other plants, are examples. Groups 1 and 2, although, strictly speaking, they bear hermaphrodite flowers, are practically monœcious.]

3. Flowers which are dimorphic or trimorphic are for all practical purposes monœcious, like the above groups, for a similar reason—viz., to secure natural cross fertilisation, and thus infuse new vigour into the offspring, just as the hybridist or breeder of prize cattle finds an occasional cross to improve the resulting offspring, and to infuse new life and strength into old races or strains. Primulas, Oxalis, Linum, and Lythrum, are referred to by Mr Darwin as examples of this group.

4. Flowers which are self-fertilising—that is, in which the pollen fertilises the stigma and ovules of its own flower. The Sweet Violet, Wood-sorrel, some species of Indian Bellflowers, and *Juncus bufonius*, are examples.

Care necessary in Hybridising and in recording Hybrid Progeny.—Much difficulty is experienced in dealing with a wide and intricate subject like hybridisation, owing to indefinite language; and to obviate this, or as an attempt with that object in view, I hope to be pardoned by hybridists and cultivators for the following remarks and suggestions. There are clear distinctions between bigeners, hybrids, half-breeds, and crosses; and if these distinctions were duly observed, and the parentage of the male and female parents correctly given in recording the name of any new plant of mixed parentage, much valuable information would be gained. Before the record of any cross is publicly made—*i.e.*, sent for due publication to the gardening or botanical journals—the seedlings from such cross or mixed union, of whatever kind, should have attained their state of per-

fection—that is to say, decorative or flowering plants should be grown on to the flowering stage before any just and right record can be written of their collective characteristics; and the same rule holds good with foliage-plants and fruit-trees. In selecting plants for scientific experiments, it is highly necessary that those only be used which retain their natural fixity of character, and which consequently reproduce themselves true from seed when fecundated with their own pollen. Many plants which have been long in cultivation are in such a highly variable state that no reliance can be placed on any experiments in hybridising wherein they are used. Among plants of this character may be named Hippeastrums, Camellias, Roses, Crotons, variegated Dracænas, Agaves, Primulas, tuberous-rooted Begonias, and many others. As I have said, the want of definite information as to hybrid or cross-bred offspring of plants is very great; but although the parentage of many of the hybrids enumerated in this work is open to question, the great and practically important point still remains, that they are not only distinct from their supposed parents, but also quite different from all other known plants. Nevertheless, as we trust to the hybridist at home to give us proof of the natural or accidental hybridisation of plants abroad—*i.e.*, in their native habitats—we must also insist on his being a trustworthy and skilful operator before we place faith in his records, even though those records be the supposed hybrid offspring themselves; since seminal variation, the sudden development of latent characters or "sports," or the increase or decrease of health, as in the case of seedling variegated plants, may each or a combination of all produce the change attributed to hybridism. For example, the flowers of the seed-bearing plant must be carefully emasculated before there is the shadow of a chance that pollen can have escaped from the anthers. The female plant must then be isolated from all other plants at all related to it, and the pollen of the intended male parent must be applied to the stigma in its pure state, and not with a camel's-hair pencil which has been used indiscriminately for applying all sorts of pollen. It is not enough to isolate a seed-bearing plant in a greenhouse, unless due precautions are taken against the possible entrance of wind-wafted pollen from allied plants in contiguous houses or from adjoining gardens. Hence comes it that botanists and intelligent observers are always suspicious of the parentage of hybrids and varieties as given by the majority of cultivators who raise florists' flowers. For botanical purposes hybrids raised between different genera or species of Orchids or Asclepiads, where the pollen is in firm, heavy

masses, and where fertilisation cannot take place except by insect agency or by direct artificial means, are the most trustworthy, for reasons already explained. We have several Orchids imported from abroad which are supposed to be natural hybrids, such as *Phalænopsis roseo-Schilleriana* (*P. Veitchii*, Hort.), *P. Schilleriano amabalis* (*P. leucorrhoda* and *P. Casta*, Hort.), *P. roseo-amabilis* (*P. intermedia* and *P. intermedia Portei*, Hort.) There are also several Odontoglots of the *O. crispum* and *O. Pescatorei* group, and others of the *O. gloriosum*, *O. nævium*, and *O. triumphans* types, which are presumably natural hybrids, just as the forms of each, technically known as "good" and "bad" varieties, are known to be the result of seminal variation. Now, if we give the hybridiser the supposed parents of any of our supposed natural hybrid Orchids or other plants, and he produces us hybrid offspring like our presumed hybrids as imported, we have, of course, good proof of the fact hitherto only supposed; and artificial hybridism, if thus intelligently and carefully employed (aided sometimes by grafting), becomes a blessing to the systematic botanist, instead of the curse which the older professors wrongly anticipated. If due care is taken, and experiments are conducted in an intelligent and systematic manner, the producer of the commonest florists' flowers may also contribute his mite to the store of organised knowledge, and thus illustrate the force of the rule that science and practice should go hand in hand.

Sexual or Elective Affinity.—Now, as when Gaertner wrote nearly thirty years ago, we know comparatively nothing as to the causes or conditions on which the power to produce generic or specific hybrids depends. Some species which closely resemble each other in general appearance and time of blooming will not blend; while others widely different in habitat, time of flowering, colour, and other particulars, mix very readily. The species of Rhododendron, Calceolaria, Pelargonium (not Geranium), and Dianthus have great elective affinity, and reciprocal unions may in nearly every instance be made. Evergreen Rhododendrons mix with deciduous Azaleas, and shrubby Calceolarias reciprocally with the herbaceous species; yet, as Gaertner observes, the aptitude amongst species even for union is scarcely ever present in an equal degree, nor is it necessarily reciprocal, but greater or less on one side than the other. The number of perfect seeds produced and the vigour of the resulting offspring may be taken as a tolerably safe index of the affinity between either genera or species; and where sexual affinity is entirely wanting on the one hand, the production of fertile seeds is but rarely carried out, and the

resulting offspring are, as may be supposed, wanting in constitutional vigour. As observed by De Candolle, the three primary colours, red, blue, and yellow, are rarely found united in the same species or even in the same genus; and the same chemical causes which affect colour may possibly be connected with this interesting question of sexual or constitutional affinity, since, as Gaertner observes, it is not governed by either systematic or morphological laws. Observing cultivators, and especially hybridisers, may greatly facilitate the solution of this problem by carefully recording the parentage of the hybrids they raise.

Balance of Sexual Power and Prepotence.—I may here remark that the late Dr Lindley believed that superfœtation was possible, although not probable, unless the flowers were carefully emasculated, since, as a rule, pollen of the same species is prepotent, though in one or two known instances, notably in the case of some Passion-flowers, their own pollen is impotent, while that from another plant of the same species or from another species induces fertility. The late Dean Herbert, writing upwards of thirty years ago, remarks: "In some genera we find that all the species are capable of breeding together and producing fertile offspring; in Hippeastrum, that they even prefer breeding with each other; in some genera, that many species will cross together, and some have as yet refused to cross; in some, that the cross-bred plants are abundantly fertile, in some obstinately sterile; in some, individuals capable of fertilisation by the pollen of another, and not by its own; in some cases, that two individuals will breed freely with a third, and not with each other." The sympathies of plants will remain a mystery to us until we estimate their sexual vigour and its causes apart from mere vegetative growth, which is often very deceptive; indeed, as a rule, barren plants vegetate much more vigorously than such as are fertile, and this is notably the case with hybrids that are barren or do not produce fertile seeds. It is a fact, but one too little appreciated, that fruit or seeds are not beneficial to the plant as an individual, but rather prejudicial, since many plants become starved to death annually by their fruit, which appropriates all the nourishment taken up by the roots. As to the prepotence of the male or female parent, the whole thing seems to hinge on perfect health and constitutional vigour—that is to say, if the male and female parents are equal in constitutional energy and sexual vitality, then the progeny will be intermediate between any two species. But in the case of varieties there is the tendency to ancestral reversion to overcome in addition, and it is well known that the

pollen of another variety of the same race is but rarely potent enough to overcome this reversional inclination; and in order to fix or render permanent any race of varieties, the pollen of a third species or robust variety of another race seems almost an absolute necessity; for where varieties of the same race are inter-crossed we get infinite variety, but no fixity of character either in vigour, size, colour, or form, and the tendency to revert to ancestral types shows itself continually.

Dr Denny's theory as to the prepotence of the male parent is, however, by no means a new one, since this was long ago pointed out (see Gard. Chron., 1844, p. 459). "In the midst of many experiments conducted without exactness, from which no safe conclusion can be drawn, there are some which, in the hands of such men as the Dean of Manchester, seem to justify the important inference that, as a general rule, the properties of the male parent will be most conspicuous in the hybrid. For example, Mr Herbert crossed the long yellow-cupped common Daffodil with the small red-edge-cupped Poets' Daffodil; and the seeds of the common Daffodil furnished a plant with most of the attributes of the Poets' Narcissus. The same gentleman also obtained out of a capsule of *Rhododendron ponticum*, fertilised with *Azalea pontica*, seedlings which had entirely the habit of the latter or male parent. In like manner the arborescent crimson-flowered *Rhododendron altaclarense* was raised from the seed of the dwarf pallid *R. catawbiense*, hybridised by the crimson *R. arboreum;* and when the common scarlet Azalea with its narrow leaves was fertilised at Highclere by a *A. pontica*, Mr Gowen found its seeds produced plants much more like the male than the female parent. Exceptions, or apparent exceptions, to this do no doubt exist, and hybrids could be found which are either half-way between their father and mother, or more like the mother than the father; but, as the means of judging at present exist, these would seem to be the exception and not the rule; and therefore the greater influence of the male may be taken as a tolerably safe guide in all experiments in this interesting art."

Since writing the above, I find in the 'Gardener's Chronicle,' 1855, p. 451, the following interesting remarks on the question of male or female prepotence in hybridising. Gaertner's numerous experiments gave such varied results that no inference one way or the other could be drawn. The late Dean Herbert and others, however, believed in the prepotence of the male or pollen parent, and the following eight cases are quoted:—

* 1. *Anemone vitifolio-japonica* (♂ *A. vitifolia*, ♀ *A. japonica*).

* Hybrids raised by Mr Gordon in the Chiswick Garden.

—The flowers and hardiness take after those of the male parent, the colour being intermediate.

* 2. *A. japonico-vitifolia* (♂ *A. japonica*, ♀ *A. vitifolia*).—This possesses the tenderness and ragged flowers of the male parent, and is worthless.

* 3. *Cereus speciosissimo-crenatus* (♂ *C. speciosissimus*, ♀ *C. crenatus*).—The colour takes after the male, while the habit is nearly that of the female parent.

* 4. *Aquilegia fragranti-californica* (♂ *A. fragrans*, ♀ *A. californica*).—Here the offspring has the habit and flower of the male, while the colour is intermediate.

5. *Rhododendron javanico-jasminiflorum* ("Princess Royal" Hort. Veitch) (♂ *R. javanicum*, ♀ *R. jasminiflorum*).—The form of the flower is intermediate; the colour is derived from the male by the separation and retention of its rose and the rejection of its yellow, a very curious, and, as far as we know, unique case.† Leaves and habit intermediate.

6. *Mandirola Roezli* (♂ *Scheeria mexicana*, ♀ *Gesnera* (*Nægelia*) *zebrina*).—The colour is derived from the male, and the whole habit and leaves from the female.

7. *Mandirola picturata* (♂ *Gesnera zebrina*, ♀ *Achimenes mexicana*).—Here the inflorescence and flowers resemble the male parent, while the leaves and colour are intermediate.

8. *Begonia miniato-opuliflora* (♂ *B. miniata*, ♀ *B. opuliflora*).—The inflorescence and colour take after the male, leaves more like those of the female plant.

"In these cases, taken perfectly at random, it is evident that for the most part the male predominates, especially in Nos. 1, 2, 4, 7, and 8, and this supports Dean Herbert's views; but in Nos. 3 and 6 the effects of the female are most conspicuous, and in No. 5 the issue is nearly equalised; even here, however, the colour is derived from the male, as also is the case in 1, 3, 4, 6, 8, and in a less conspicuous degree in the other cases. The most curious result is that in both 6 and 7 *Gesnera zebrina* overcame the peculiarities of its consorts, whether used as male or female. This points to a conclusion not yet drawn—viz., that in some cases it is merely because of the inherent vigour of constitution that a species prevails, and not because it is male."

Hybridism and Colour.—The colour of stems, leaves, flowers, and fruit is altered by hybridising and cross-breeding, but it is in the flower that these changes are most noticeable, since

* Hybrids raised by Mr Gordon in the Chiswick Garden.

† *Begonia Weltoniensis* is a similar example of this separation of colour in the hybrid offspring.

the colours are more pure and variable in the floral envelopes than elsewhere. I shall confine my remarks mainly to the flower, and it may be as well to remind practical hybridisers that their efforts to produce any desired shade of colour will be much facilitated if they understand a little of the theory of colours, since colours not unfrequently mix or blend in flowers just as they do on the palette of an artist. The three primary colours are red, blue, and yellow; and the tissues of a plant in which these colours, or some combinations of them, are absent are white. Now if red and blue blend together the result is purple, the tint varying according to the proportion of the red to the blue, or *vice versa*. Red and yellow mixed produce orange, and blue and yellow green; and if there is more yellow than blue, the result is a light or apple green; but if there is more blue than yellow, a dark or blue green is the result; and the least change in the proportion of one colour to the other produces a different tint. If this is true, then orange flowers may be produced by crossing a red-flowered variety or individual plant with one which bears yellow flowers; and in many cases this can be done. Red and yellow flowered varieties or species of Zinnia, if crossed, always yield a fair percentage of orange-coloured flowers, although they vary in depth or richness according as the red or yellow elements predominate. Some plants naturally produce orange-coloured flowers, and it is singular to note that when orange-flowered plants are crossed with white-flowered ones, the yellow element often disappears altogether, and the result is a hybrid or cross-bred plant with red or pink flowers. We have an example of this result in *Begonia Weltoniensis*, which is a rosy-flowered hybrid from the white-flowered *B. Dregeii*, fertilised with pollen from the orange-flowered *B. Sutherlandii*. Blue and yellow flowered plants do not readily cross with each other, however nearly related; and if they do so, the colour of the progeny reverts either to the male or female parent; indeed, if these colours were to blend in the floral envelopes, the result would be a green-flowered plant. If red and blue flowered varieties of the common Hyacinth are carefully cross-fertilised, the result is seed which produces seedlings of three kinds,—part having red flowers; another group with blue ones, according as they take most after either parent; and a third set with intermediate characters, and having purple flowers, some reddish-purple, some blue-purple, and others of a delicate mauve colour. Where purple and white flowered plants are hybridised, as *Petunia* (*phœnicia*) *violacea* and *P. nyctaginiflora*, the result is pale rose or rosy-purple flowered forms, others having

white flowers; and in seedlings from these the colour breaks out in a multitudinous series of blotchings, streaks, and markings of various shades, just as the primary colours red and blue predominate, and are either condensed in small patches, or suffused over the whole surface of the flower. In the show Pelargonium we have scarlet (that is, very bright red), purple, and rose or pale red in various proportions, every change in proportion giving a different set of colours, and consequently a new variety. In many plants the colours are always the same; but in every batch of seedlings the variations of these colours, either in locality or unison, are really wonderful. This type of variation has been aptly described as resembling that of the kaleidoscope, in which the elements or coloured fragments are always alike, but the arrangement different at every revolution. Dr Denny thus writes on the blending of colours in the case of cross-breeding varieties of *Pelargonium zonale* and *P. inquinans* (see Florist, 1872, p. 51): "My notes indicate that the magenta shades are the result of the mixtures of pink, or lilac and scarlet; the magentas and scarlets produce various shades of crimson and maroon, according to the depth of the scarlets; white and scarlet salmons; and, strange to say, salmon will not unfrequently result from the crossing of two * scarlets; but the extent of the blend, and the variations which result from the mixture of colours, depend upon the respective constitutions of the plants employed. Probably no blend at all would result if the pollen parent possessed both a decided colour and the greatest vigour. I find that the production of a brilliant and novel colour is accompanied by a primitive form of petal † which causes the difficulty in obtaining the combination of novel colour and good form." In the genus Narcissus we have some curious changes effected in the flower, and especially in the cup, by hybridisation. The late Dean Herbert produced a plant identical with *N. incomparabilis* by fertilising the wild Yorkshire Daffodil (*N. Pseudo-Narcissus*) with pollen of the Poets' Narcissus (*N. poeticus*) (see Bot. Reg. 1843, p. 38). Everybody knows the Daffodil has an extinguisher-

* I have noticed this phenomenon, and consider it due to the fact that the colour, instead of being confined to the cuticle of the petal, becomes mixed with the *white ground*, which normally lies beneath the layer of cells containing the scarlet pigment. I also notice that salmon-coloured varieties, resulting from a union of two scarlets, are apt to be striate more or less, and the petals become scalded in bright sunshine.—B.

† It is doubtless the narrow petal which accounts for the richness or novelty of colour, since, if the petal was a broad and rounded one, the colour would be less vivid and distinct, simply because diffused over a larger area.—B.

shaped *deep yellow* cup about an inch in length, while the cup of the Poets' Narcissus is flat or shallow, yellow also, but having a *reddish-purple* ring round its margin; and in the hybrid resulting from these two species, we find the margin of the yellow cup suffused with *deep orange*, which is just the colour obtained when we mix *reddish purple* and *deep yellow* on the palette. The Poets' Narcissus crosses freely with some forms of the Polyanthus Narcissus (*N. Tazetta*), even in a state of nature; and by crossing it with some of the pure white varieties, as *N. Tazetta papyracea*, it is not improbable that rosy or lilac cupped varieties might be obtained. From the above facts it is evident that in some cases the colours of varieties or species, when crossed, are mixed or blended just in proportion to the elective affinity or sexual vigour of either parent, which, indeed, often varies in each seedling or individual produced; while in other cases one colour only predominates in the flower, the other being rendered latent, or perhaps attracted to some other part of the plant (see Datura). This latter kind of colour variation points to the manner in which "blue Roses," "blue Dahlias," and "blue Pelargoniums" will be originated, if such a consummation is ever effected at all. In all these flowers a certain amount of blue is present, but mixed with red in various proportions, the result being lilac or purplish flowers. Now, in order to produce blue flowers, all the red colouring matter must by some means or other be either suppressed entirely, or driven to the stem and leaves, for so long as it retains a place in the flower, it is simply impossible that the flower can be a blue one. Considerable progress has been made in suppressing the red in purple-scarlet Pelargonium flowers, and the late Donald Beaton's "Indian yellow" is an example of the suppression of red colouring matter to a certain extent in an orange-scarlet flower. In hybridising such plants as Begonias of the foliage section, or in crossing tricolor Pelargoniums or Caladiums, some curious changes of colour are perceptible. In tricolor Pelargoniums, for example, we have the green colour of the leaf (blue and yellow) separated to some extent, and some of the red colour which normally belongs to the flower is introduced. Now, if the red cells of colouring matter overlie the green parts of the leaf, the result is a brown tint; while, if they lie over the yellow portions, the red or pink becomes warmed into scarlet. In some tricolors —the silver race—the yellow portions of the leaf are replaced by colourless cells—*i.e.*, cells containing colourless fluid; and when the red variegation lies over this part of the leaf, the result is a clear rose or pink hue, changing at once

into purple or brown when it stretches into the green parts of the leaf.

*Fixation of Varieties and Races.**—The "fixing" of any variety by artificial means, such as suitable culture, careful selection of seed, &c., is easy to the intelligent cultivator; and whenever a "break" or "sport," or cross-bred seedling of a desirable character, or exhibiting a tendency towards any standard of excellence, makes its appearance, other excellences soon follow under the fostering care of the horticulturist.

"The florist, to 'fix' the form, carefully isolates the plant; but in the wild state a distinct sport or seminal form has no chance, the bee from the neighbouring flower of course fertilising it with the pollen from any of the other forms. If there were no bees, no agency whatever for cross-fertilisation, nothing but the plant's own pollen to depend on, there would undoubtedly be anomalous races, which, again, by natural evolution at times changing, would produce other races; and in time the difference might be so great as to be even thought generic. But we see that, by the agency of the humble-bee, the progress of the newly-evolved form is checked. The pollen of the original form is again introduced to the offspring, and it is brought back at least half a degree to its starting-point. Insects, in their fertilising agencies, are not always abettors, but rather at times conservators of advancing evolution."—(Meehan.)

When the florist cross-fertilises two pure species, the offspring which result from the union possess a general family likeness, although the elementary characteristics of the two species may be united in different proportions in the different individual seedlings. Races thus obtained are, however, far from constant in character as a rule, unless again crossed with a third species, or with a distinct variety of a third species, which, I have repeatedly observed, has the effect of fixing the characters of seedling races; but why this is so, I cannot just now explain. Careful selection and good culture (*i.e.*, a system of culture which most favours the development of the characteristics we wish the seedlings to assume, and which least favours those characteristics we do not require) are the most powerful aids in fixing or rendering permanent races and varieties. Plants, like animals, adapt themselves within certain limits to the soil and locality or climate in which they may be placed;

* Those interested in this phase of our subject will find much useful information in a work by M. Carrière, entitled 'Production et Fixation des Variétiés dans les Végétaux.'

and thus habits are formed which in time become permanent, and which are reproduced from seed.

In illustration of the foregoing remarks, and to show more plainly how races have already been fixed by intelligent hybridists, the following tables of parentage or pedigrees are given :—

RHODODENDRON.

Race 1.

R. Catawbiense × *R. arboreum*	Altaclarense	*R. Catawbiense* × Altaclarense	Blandyanum. Towardii. Meteor. Elegans. Nobleanum bicolor. Pulchellum.

Race 2.

R. Ponticum × *R. maximum*	Hybrid maximum	Hybrid maximum × Altaclarense	Standishii Mrs Loudon. Picturatum. Vivid. Captivation. Racanum.

CLEMATIS.

C. viticella × *C. integrifolia*	Hendersonii	*C lanuginosa* × Hendersonii × *C. viticella atrorubens*	Jackmannii. Rubro violacea. Viticella pallida. ,, Mooreana ,, amethystina. Prince of Wales. Rubella Magnifica. Alexandra. Velutina purpurea.

BEGONIA.

B Veitchii × *B. Boliviensis*	Intermedia × Sedeni	Acme, and others.
B. species × *B. Boliviensis*		

Mixed Pollen.—The idea of mixing the pollen of several plants—that is, either closely-related species or varieties—together, in order, if possible, to obtain greater variability or mixed qualities in the offspring produced, has suggested itself to many hybridisers, but in practice (that is, in the origination of new flowers or fruits) it has little if anything to recommend it; while, from a scientific point of view, the results of such fertilisation are too uncertain to be of any value, since even when only one kind of pollen is employed great precautions must be taken and everything noted with great exactness in order to render the results obtained of any scientific interest. In the 'Journal of the Royal Horticultural Society' for 1850, vol. v.

p. 161, the following translation of Gaertner's observations on this subject is given: "When the stigma is dusted at the same time or within certain limits with its own pollen in *sufficient quantity* and that of some other species, the latter is *wholly inert*, and the result is plants not differing in any respect from the matrix: nor is the effect different if a division or portion of the stigma be dusted with either pollen separately, precaution being taken that there shall be no possibility of admixture. The elective affinity (see page 119) for the natural pollen makes the other completely negative. The result is perfectly analogous when more than one kind of strange pollen is applied, the native pollen being completely excluded. One typical form alone results—the effect of the impregnation of that pollen for which the stigma has the greater elective affinity." The late Dean Herbert (see Herb. Am. p. 375) attempted to fecundate *Calceolaria plantaginea* with the pollen of twelve other species industriously mixed together; but very few seeds ripened, and the result differed but little from seedlings obtained by fertilising with one kind of pollen. He further remarks that in Crinum he has obtained mule and natural seed from the same capsule; and where there are three distinct stigmas, as in Passiflora, it would be interesting to fertilise each very carefully with pollen from three other species and note the result: indeed, the glimmerings of successful superfœtation which now and then appear seem to beckon the hybridiser onwards, and suggest a careful series of varied experiments. In cases where mixed pollen is used, the number of seeds is generally small. Gaertner, however, relates a curious exceptional instance: "A plant of *Lychnis diurna* was dusted with pollen of *Silene noctiflora.* Twelve capsules of different degrees of perfection were set, which yielded from twenty to eighty seeds. The plants produced by them were, with two exceptions, true *L. diurna;* but these had smaller leaves, a more vigorous growth, and stronger but more finely divided branches. It is possible that the main crop was due to the presence of stamens in the *Lychnis*, which is not always strictly diœcious, the two abnormal forms being due to the hybrid fecundation. The experiment was repeated, but did not succeed. Mr Herbert has occasionally observed, in the case of multilocular capsules, hybrid and natural seeds in the same plant. Such cases are, however, of extreme rarity."

The mode of experiment may be varied by dusting the stigma at different intervals with the different kinds of pollen. It is clear, however, that the strange pollen must be applied first, to have in general any effect on the result. If impregna-

tion has taken place, which in different genera requires very different periods—as in Nicotiana two hours, in Malva and Hibiscus three, in Dianthus five or six, &c.—the application of the native pollen has no effect. The fruit is not more perfect, the seeds more numerous or different in their nature, nor is any superfœtation effected; but the small number of seeds is precisely such as would have been generated by the simple hybrid fecundation. Two kinds of seeds were, however, produced in *Nicotiana rustica* impregnated with *N. paniculata*, by dusting half of the stigma with the strange pollen before the expansion of the corolla, and the remainder after a lapse of twenty hours; and the conditions of the experiment were varied till the pure type vanished entirely, and merely the usual bastard type made its appearance. The account of the experiments is very interesting, but too long for extraction.

A mixture of pure and hybrid seeds can only take place when the strange pollen is applied first, and the native pollen before the intrusive has affected the whole of the ovary, either by impregnating the ovules or destroying their vitality, or before the surface of the stigma has undergone such a change as to make impregnation impossible; or in the case where the native pollen is first applied in extremely small quantity, and the intrusive pollen after a very short interval.

The occurrence, however, as said above, of the pure and bastard type from the seed of the same plant is extremely rare, and can only happen under very peculiar circumstances; but even a threefold produce is not absolutely without example, the successive impregnation of *Nicotiana paniculata* with *N. quadrivalvis* and *N. Langsdorfii* having given rise to three types; three plants proving the pure species, four the hybrid *N. paniculato-Langsdorfii*, and a single individual *N. paniculato-quadrivalvis*. A repetition of the experiment produced merely the latter hybrid form.

An important deduction arises from these exceptional cases. Even in this compound fecundation there is no confusion of types, but the hybrids are exactly such as would have arisen from a simple impregnation with the pollen of one allied species. In the course of a long series of experiments, seeds have occurred very rarely containing more than one embryo; *

* Mr Thwaites has found a compound embryo in the genus *Fuchsia*. Two forms were grafted together, one possessing the character of *F. fulgens*, the other of *F. magellanica*. It is clear, however, from his account, that they did not arise from a union of pure species. The seedlings were too varied to allow of such a supposition. See Ann. of Nat. Hist., 2d series, vol. i. p. 163.

and as it is possible that a pollen-tube from either kind of pollen might have simultaneously entered the ovule, these seeds might have contained two embryos of a different nature; such, however, was never observed to be the case.

Imperfect or Partial Fertilisation.—The following remarks on this portion of the subject are from the late Hon. and Rev. Dean Herbert's paper in Hort. Soc. Jour., vol. ii. p. 1 *et seq.*:—

"Whoever tries to raise mule Alstrœmerias from *A. aurea* by some cognate species will find, under favourable circumstances, every flower produce a full-sized perfect capsule, though he may fail in obtaining the least enlargement of the ovules. A mule raised by Mr Bidwill between *Passiflora cærulea* and *P. onychina* flowered this summer in my conservatory, and produced of itself, to my surprise, two fine plump fruits, two inches long, of a bright orange colour, there being no other Passiflora in flower at the time on the premises. On opening its beautiful fruit it proved to be empty as a bladder, the outer coat of the fruit only having been fertilised, in consequence of the weakness of the cross-bred pollen. [Cucumbers often produce fruits in this way, without any trace of fertile seeds.] In other attempts at cross-breeding, or in plants that do not make seed freely in our climate, he may find not only a perfect capsule, but seeds grown to a full size, though containing a perishable lymph, and no sound kernel. In others he may find the seed either of an undue texture and substance, or, if apparently good, deficient in embryo. In some cases, as in the very extraordinary one first noticed by Mr Brown with respect to Hymenocallis, the seed having no discoverable embryo when first ripened, acquires one after lying for some weeks or months on the earth. It follows, therefore, that a continued operation of the pollen must be necessary to produce all these requisites for the formation of a good seed. It has been said that when the ovules are fertilised the outer coat or capsule begins to swell. This does not appear to be true; for the capsule often becomes perfect, though the ovules do not seem to have become fertilised at all. It seems, therefore, a process independent thereof, whether simultaneous, antecedent, or posterior; so must the fertilisation of the seed-coats and of the albumen be, since they may grow without an embryo: and some mysterious process must be continued to vivify the embryo at a later period, since it can elude the microscopic research of Mr Brown in a seed so large as that of Hymenocallis. I have cut open seeds of Hymenocallis an inch and a half long, and found no visible embryo, but a large cavity; yet

the rest of them, being left in the damp ground, acquired visible embryos, and sprouted some months after. If, therefore, as I apprehend, the pollen-tubes cannot reach the ovules without deriving substance from the cognate juices of the style through which they descend, it becomes easy to understand how there may be sufficient affinity between them to carry on the process to the degree necessary for quickening the capsule, but not to carry it on to the point requisite, and with the excitement and irritability necessary for reaching the ovule, and stimulating it to open its aperture for the reception of the substance conveyed by the tube from the interior of the grain of pollen. It is also easy to understand how moisture, either to feed the plant inwardly and make its juices abundant, or to affect the stigma outwardly, may be necessary to the fertilisation of the ovules. If a chemist could analyse the pollen before application, and the tubes after, perhaps it would appear that the pollen is deficient, and, in order to be available, must be deficient in some one of the ingredients which will be found in the tubes. If it be true, as I imagine, that it is necessary for the pollen to derive from the style some chemical adjunct to increase its bulk, and to enable it to irritate the aperture of the ovule and obtain access, it will become manifest why it is that in some genera intermixed produce is easily obtained—in others not; because it depends upon the close similarity of constitution and chemical relation of the component parts of the two plants. We can easily understand that the individual which on a hot and barren soil dwindled, after the dispersion by the Deluge, to a slender annual, may have acquired such different chemical qualities, that it has not now such sufficient affinity to the species which in a moist and luxuriant position has become a master of a forest, twining its colossal arms round the loftiest of its inhabitants; while two other species, though very different in some striking points of conformation, may have such constitutional similarity, and such identity of component ingredients, as to have precisely the same chemical affinities and intermix readily. Why is it that in the genus Hippeastrum all the several natural species, forms, or varieties of that plant (I care not by what title their variation is styled) breed more readily by the pollen of any other, however complicated by cross-breed, than by its own; and that in the genus Habranthus, most closely allied to it, every attempt to cross the several natural sorts has as yet entirely failed? The facts are so. Why is it that in the genus Zephyranthus, closely akin to Habranthus, and making seed freely, crosses are obtained with much difficulty, and, when obtained, are rather disposed to

sterility? I cannot answer those questions, further than by saying that the ways of the All-wise are past finding out; but I can surmise that in the genus Hippeastrum there is a great sameness of constitution, and that the pollen finds in the style exactly that which is requisite for the growth and development of its tubes, and that the pollen of a fresh individual with the same chemical properties gives a more powerful stimulus, as the introduction of a fresh cross has been found to do amongst animals; and that in the two other genera there is less sameness of constitution, greater difference in the proportions of the component parts of their juices, and the pollen is not suited with what it wants for the purposes of fertilisation. I suspect, therefore, that it is by the nice adaptation of the juices of each individual type to yield the exact proportion of what is wanted for the pollen of its kind, that the Almighty has limited the races of created things; and that, wherever that adaptation is perfect, a perfect offspring is produced. Where it is not perfect, an inadequate or a weak fertilisation takes place. It is further to be observed that there is frequently an imperfect hybrid fertilisation, which can give life, but not sustain it well. There are several crosses which I have repeatedly obtained, but could not raise the plants to live for any length of time. I obtained much good seed several years ago from *Hibiscus palustris* by *H. speciosus;* I sowed a little each year till it was all gone; the plants always sprouted, but I saved only one to the third leaf, and it perished then. I have never raised beyond the third or fourth leaf a cross between *Rhododendron ponticum* and an Orange Azalea, though I have saved two or three through the first winter. My soil, however, is very uncongenial to them, and under more favourable circumstances they would have been saved. From *Rhodora canadensis* by *Azalea pontica* (sections of genus Rhododendron), I saved ultimately only one out of more than one hundred seedlings, and that became a vigorous plant. Such crosses sometimes are a hundred times more delicate in their first stage than natural seedlings. Mr Bidwill, in attempting crosses at Sydney, has also (as he informs me) raised some with difficulty, which have invariably perished. In these cases I apprehend that, although the affinity of the juices is sufficient to enable the pollen to fertilise the ovule, the stimulus is insufficient, the operation languid, and the fertilisation weak and inadequate to give a healthy constitution. It has been generally observed that hybrid fertilisation is slower than natural fertilisation, and that often a much smaller number of ovules are vivified. The same cause probably operates in that respect: the affinity not being perfect, the necessary

ingredients are attracted by the pollen less readily and insufficiently, and by many of the grains not at all.

"It appears that if two stigma-bearing lobes of a triple or even tripartite style are cut off, the whole germen may be fertilised by the one left. In such cases, therefore, the pollen-tubes from one lobe must be able to penetrate all the cells of the germen. In cases such as I have seen, where both natural and hybrid seeds have been produced in one capsule, I cannot state whether the two sorts of pollen acted through the same or different lobes. I have *in no instance* succeeded in obtaining any multiplicate cross by blending the pollen of two or more kinds intimately before their application. Mr Knight thought he had given at the same time the curl of one cabbage and the red colour of another to a third variety. My invariable failure in such attempts induces me to think his recollection was inaccurate, if he meant that he had done so at one fructification. He might easily have obtained the twofold features by two successive crosses, but I believe not in one generation by simultaneous application of different pollens; for I do not think that two grains even of the same pollen can get effectual access to the foramen of one and the same ovule.* I now understand, nearly at least to my own satisfaction, in what manner the pollen of Rhododendron may in the fertilisation of the ovules supersede the pollen of Azalea previously applied; because I do not believe that they are always fertilised so soon as has been usually supposed. The stimulus may have been given to the germ or outer coat of the seed-vessel, and yet the fertilisation may not have reached the ovule, and the operation which produces a living embryo may remain suspended till a change of weather and a moist atmosphere afford a supply of carbon, or whatever is needful thereto; and therefore that pollen which has perfect affinity to the plant may develop itself effectually at a later period on a change in the state of the atmosphere; but when the pollen has once reached and stimulated the foramen, further access will be assuredly denied. I have repeatedly observed in dry seasons the pollen of Rhododendron very parched and seemingly deficient, the stigmas dry, and the germens remaining for weeks nearly stationary after flowering, as if no seed would be produced; but upon a change of weather inducing moisture, universal fertility of the pods soon became apparent. I suspect that in such cases the fertilisation has remained incomplete from want of the food necessary to

* It is now known that it is quite possible for two pollen-tubes to enter the apical aperture or foramen of the same ovule.

the elongation of the tubes. If such views have any foundation in truth, it is possible that, in addition to mere water, a supply of the chemical ingredients which are the food of plants to the style may facilitate difficult impregnations.* It is certainly desirable, where dry pollen is to be tried, to moisten the stigma to which it is about to be applied.

"I therefore recur to my first objection, that it is utterly impossible that such a minute body (the pollen-grain) should emit such a pipe and its contents—that is, emit it of its own substance; and I apprehend the fact to be, that by contact with the juices of the cognate plant it acquires that which enables it to gain bulk for such an elongation. I conceive that the abstraction of something, perhaps carbon, from the juice of the stigma, is necessary to that increase of bulk, and in some cases that atmospherical moisture is essential to it. Hence it arises that old pollen which has been kept perfectly dry may act so as to fertilise, but that which has been once damp cannot do so, because it has been carbonised and has discharged its office, and is incapable of acting a second time. But the probability is that, although mere moisture may have a certain effect on the pollen, there is some more chemical union between the grain of pollen and the juice of the plant necessary to carry the duct to its distant point of reception, and enable it to make good its entrance when it arrives there. It has, I believe, not been duly considered, that the fecundation of the ovules is not a simple but a complicated process. There seem to me to be three or four several processes—the quickening of the capsule of the fruit, the quickening of the outer coats of the seed itself, and the quickening of the internal part or kernel, and the quickening of the embryo."

Notable Modes in which Artificial Fecundation is possible.—M. Lecoq mentions the following modes in which artificial fecundation may be conducted; and a series of carefully-recorded experiments carried out on different individuals of the same pure species, as follows, would be very valuable from all points of view:—

First Degree.—The flower is fecundated with its own pollen—that is, pollen from the same flower in which the stigma is to be fertilised.

Second Degree.—The flower is fertilised with the pollen from another flower on the same spike or inflorescence.

Third Degree.—The flower is fertilised like the last, but the pollen is taken from a flower on another spike or panicle on the same plant.

Fourth Degree.—The flower is fertilised by pollen from the same species, but taken from a separate individual.

Fifth Degree.—The female flower is fecundated by a male flower taken from the same branch or off the same inflorescence.

Sixth Degree.—The female flower is fertilised by a male flower taken from a different inflorescence borne by the same plant.

Seventh Degree.—The female flower is fertilised by the pollen of a male flower of the same species, but from another individual.

Eighth Degree.—The flower hermaphrodite or unisexual is fecundated with pollen of another variety of the same species.

Ninth Degree.—The flower hermaphrodite or unisexual is fertilised by pollen of a distinct species.

Tenth Degree.—The flower unisexual or hermaphrodite of an hybrid is fecundated with pollen of another hybrid variety.

To the foregoing we may add the following :—

Eleventh Degree.—The flower unisexual or hermaphrodite of a species in its pure state is fertilised with pollen from a cultural variety of the same species, or *vice versâ.*

Twelfth Degree.—The flower hermaphrodite or unisexual of a pure species is fertilised with pollen from a hybrid variety of another species, or *vice versâ.*

Thirteenth Degree.—The flower of a pure species is fertilised with pollen from a species belonging to an allied genus.

Fourteenth Degree.—The flower of a monœcious or diœcious plant is fertilised by pollen from the hermaphrodite flowers of an allied genus or species, and *vice versâ.*

If careful records were kept of all hybrids between evergreen and deciduous, bulbous and fibrous-rooted, erect-growing and scandent-habited plants, or poisonous and edible or innocuous plants, much useful information would be obtained. As will have been observed by the foregoing remarks, there are several ways in which new forms of plant-life may be originated, or old forms modified, and for the sake of convenience these may be here tabulated together as follows :—

*Bigeners or Bigeneric Hybrids.**—These plants are obtained

* Among bigeneric hybrids, Mr Weddell has indicated the following (See Ann. des Sc. Nat., 3d ser., vol. xviii., 1852) : *Lychnis and Saponaria, Ervum and Vicia, Lychnis and Cucubalus, Ipomæa and Convolvulus, Nicotiana and Datura, Papaver and Chelidonium, Papaver and Glaucium, Lanateria and Hibiscus, Aceras and Orchis ;* and to these may be added, *Philesia and Lapageria, Phaius and Calanthe, Libonia and Sericographis, Calanthe and Limatodes.*

by crossing two pure species belonging to different genera. Examples: *Phajus irroratus*, *Philagera Veitchii*, *Sericobonia ignea* (*Libonia Penrhosiana*), and *Calanthe Veitchii.*

Bigeneric Half-breeds are plants obtainable by crossing varieties of two species belonging to different genera.

Hybrids or Mules * are the products of two species. Examples: † *Rhododendron altaclarense*, *R. hybrid-maximum*, *Clematis Hendersonii*, *Cypripedium Harrissianum*, *C. Sedeni*, *Cattleya Exoniensis*, *Calanthe Veitchii*, *Lælia flammea*, *Delphinium formosum*, *&c.*

Half-breeds or Mongrels are the products of two varieties of one species. Examples: Many Primulas of the *P. sinensis*, *P. auricula*, or *P. vulgaris* sections; many Peaches, Plums, and other cultivated fruits.‡

Graft Hybrids are the results sometimes produced by uniting two species as scion and stock. Examples: *Cytisus purpurascens* (= *C. Adami*).—(See *Cytisus.*)

Graft Half-breeds.—These are produced by grafting varieties of a species together, several instances of intermediate products having been observed in Potatoes, &c.

Seminal Sports are varieties which not unfrequently result from seeds which have not been fertilised by foreign pollen; indeed, seminal variation, natural selection, or "survival of the fittest," is nature's way of adapting plants to different localities and conditions. Many garden plants have been

* The word "mule" is frequently used as synonymous for hybrid, and originated at the time when hybrid plants (like hybrid animals) were thought to be universally sterile. It being now known that but a small proportion of hybrid plants are absolutely sterile (M. Naudin thinks about 25 per cent), even in the first generation, the word hybrid should be exclusively used for the fertile progeny of two species, and the word mule adopted in like manner for such as are sterile.

† Professor Sachs gives the following definition of the different kinds of hybrids: "According as the union takes place between different varieties of one species, different species of one genus, or between two species belonging to different genera, the resulting hybrid may be termed a variety-hybrid, species-hybrid, or genus-hybrid. When a hybrid is made to unite with one of its parent-forms, or with another parent-form, or with a hybrid of different origin, the product is termed a derivation-hybrid."

‡ It will be seen that inter-crossing is not always conducted regularly according to our table, and in many cases becomes so complicated as to preclude the possibility of classification, except in a large treatise especially devoted to such an extensive and intricate subject. For example, instead of crossing two pure species belonging to different genera, so as to produce bigeneric hybrids, we may employ one pure species and a half-breed or sub-variety of another species and genus, and then we have a bigeneric half-breed intermediate between a true bigeneric hybrid and a bigeneric half-breed; and so on, in the case of the other classes.

improved largely by carefully selecting such seminal forms as come up to our assumed ideas of perfection or the fashion of the time.

Bud Sports are variations originating from a "bud, tubercle, or other organ of a single individual by division or extension." Decandolle says: "Sports must originate from certain causes, as an ancestor of a different form, an actual or anterior influence of climate, &c.; but the obscurity of these causes is precisely what justifies the use of the word."

NATURAL FERTILISATION AND CROSS-BREEDING.

RECENT OBSERVATIONS ON THE FERTILISATION OF PLANTS.*

It is proposed in the following section to give an account of some of the most recent observations on the subject of the contrivances by which the fertilisation of flowers is effected; a subject the details of which are so numerous and varied that the field of observation open, not only to the scientific botanist, but even to the ordinary observer, seems almost boundless. So much has now been written on this subject, that every one who has followed it to any extent is aware that the greater number of flowers are cross-fertilised—though to this rule there are exceptions, to which we shall allude presently—and that the mode in which this cross-fertilisation is usually effected is by the agency of insects. There are, however, a considerable number of flowers which are fertilised without the assistance of insects, by means of the wind; and as these present, as a class, peculiar features of their own, we may spend a little time in the first place in considering them.

The Agency of the Wind.

A familiar example of flowers fertilised in this way is furnished by the common Hazel, which flowers from January till the early part of March, even when the weather is very cold, and when there are scarcely any insects on the wing. The flowers of the Hazel are of two kinds, male and female. The male flowers constitute the familiar catkins, which drop off and disappear before the leaves make their apearançe. The catkins are generally in bunches of from two to four, every catkin containing on an average perhaps from 100 to 120 flowers. Each of these male flowers consists of a simple scale-like bract enclosing from eight to twelve anthers, each of which dis-

* By A. W. Bennet, M.A., in the 'Popular Science Review.' Reprinted by permission of the author.

charges, when ripe, a cloud of innumerable pollen-grains; so that the number of these grains in any single catkin must be prodigious. The female flowers are found on the same branches as the catkins, and are also in clusters of from two to six or eight (the future nuts), and are of equally simple structure with the male flowers, being formed of a single pistil enclosed in bracts, the ovary surmounted by from three to five stigmas, the bright crimson threads by which these female flowers are recognised. If one of these crimson threads is placed under an ordinary pocket-lens, it will generally be found to have on its surface several apparently minute particles of dust, which, on further examination, are found to be pollen-grains which have been blown from the male flowers. Each individual pollen-grain has the power of emitting a "pollen-tube," which penetrates the stigma, reaches the ovary, and by the fertilisation of the ovule induces the formation of the embryo, and thus the development of the ovule into the fertile nut. Since the only means by which the pollen can be conveyed from the male to the female flower is the agency of the wind, and it is only quite by chance that any of the grains can reach their destination, the reason is obvious of the enormous amount of pollen with which the catkins of the Hazel are furnished. In some plants, the fertilisation of which is effected in the same manner, the quantity of pollen is still greater, and this is especially the case in the Coniferæ or Fir tribe. If a Yew-tree is struck with a stick or agitated by the wind at the time when the pollen is being discharged, it will rise in the form of dense smoke, giving the impression of a burning bush; and American travellers have described how the water of some of their lakes near the shore is covered at certain seasons by a thick stratum of a sulphur-like substance, the pollen blown from the neighbouring Pine-woods. Whether the female flowers of the Hazel are fertilised from the catkins on the same or on a different bush is a point still in dispute. Another instance in which there is little doubt that fertilisation is accomplished by the wind, though botanists are not quite unanimous on this point, is that of our common cereal crops, and especially of Wheat. Important in the highest degree from a mere mercantile point of view as is any question connected with the production of our corn crops, it is only very recently that any reliable observations have been made on the mode in which the flowers of Wheat are fertilised; but these have led to some very curious results. When a field of Wheat is in flower—that is, in ordinary seasons, in the early part of June—each ear will be found to be furnished with a great number of

purplish anthers hanging at the ends of filaments of extraordinary delicacy, or rather of empty anther-sacs from which every grain of pollen has been discharged. These anthers appear, when they have arrived at maturity, to break suddenly out of the opening bud, the filament elongating in a moment to several times its original length, the anther bursting at the same time, when the slightness of its attachment to the filament causes the least breath of wind to sweep the whole of the light dusty pollen out of its case, some of which must necessarily reach the neighbouring stigmas in the same ear, provided there is not enough wind to blow it completely away. In Rye and Oats this extraordinarily rapid lengthening of the filaments is even more conspicuous than in Wheat. Hence the importance attached by farmers to comparatively calm sunny weather at the critical period when the corn is in flower. These two examples furnish good illustrations of the structure which prevails in those flowers that are fertilised by the wind. They are generally of very simple structure, and rarely brightly coloured, since bright colours would be of no advantage to them. The quantity of pollen is usually very large, and the structure of the male flowers such that it is dispersed by the wind with the greatest facility, this being brought about by the slender "versatile" filaments of the Wheat and by the lightly hanging catkins of the Hazel, the Willow, and other early-flowering shrubs, which appear before the leaves, and hence at a period when there is no obstruction to the free dissemination of the pollen. In the majority of flowers, however, the structure of the pollen, or the arrangement relatively to one another of the pistil and stamens, is such that fertilisation could not be effected by the wind alone. Sometimes the pollen-grains themselves are too large and heavy to be thus conveyed, or they are united together by fine threads or even into dense masses; or the position of the stigmatic portion of the pistil is evidently not adapted for the pollen to reach it in this way; and Nature then employs as the agent in fertilisation the services of insects or of other small animals. This opportunity is afforded by the visits of insects to the flowers in search of the honey or nectar which forms an important portion of the food of many classes.

Agency of Insects.

The attraction to the flowers which serve insects for food is twofold—scent and colour; in other words, those properties which chiefly render flowers attractive to our own senses. The

honey or other sweet juice is generally stored in small glands or receptacles, which together form the "nectary," the position of which is extremely variable—the deep pits at the base of the corolla in the Crown Imperial, the small scroll-like petals of the Hellebore, the bottom of the spur in Orchises and the Larkspur, the prolongations of two of the stamens which project into the spur of the Violet and Pansy, very frequently minute glands at the base of the stamens or pistil, &c. Nature is always economical of her resources; and accordingly we do not generally find that strong scent and brilliant variegation of colour are bestowed on the same flower. Those which are most prized for the power or delicacy of their scent have, as a rule, flowers either inconspicuous, or, if large and conspicuous, of uniform unvariegated colour; as, for instance, the Mignonette, Daphne, Primrose, Sweet Violet, Lily of the Valley, Rose, Evening Primrose, Pink (in its primitive white state), Honeysuckle, Lime-tree, and many others; whilst the most brilliantly variegated flowers are comparatively or quite scentless, as the Fritillary, Pelargonium, larger and smaller Convolvulus, Tropæolum, Mimulus, Ranunculus, Pansy, &c. In scented flowers the scent proceeds from the nectar itself, and is therefore a sufficient guide for the insects in search of it. One of the largest of scented flowers, the Evening Primrose, blossoming only in the night, is fecundated by night-flying moths, which probably require the large sulphur-yellow flowers, as well as the scent, to guide them from a distance in the dim light. A distinction may also be drawn in general terms between the mode of fertilisation of large conspicuous and of smaller variegated flowers; the agents in the former case being generally large insects, butterflies, moths, beetles, or bees; in the latter, very much smaller ones. If a watch is kept on very large flowers, such as the single Hollyhock, single Pæony, "Convolvulus major" of the gardens, the large white wild Convolvulus, Fuchsia, &c., it will be seen that their visitors mostly consist of large beetles, hive or humble bees, or butterflies; while the small flowers are overrun with small flies or other minute insects, to which the variegation serves as a guide, the streaks or rows of colouring invariably pointing to the nectary or receptacle of honey. American naturalists state that many of the largest and most gorgeous flowers of the Western continent, such as the Bignonias or Trumpet-flowers, are fecundated by humming-birds. A very good illustration of the different contrivances exhibited by two closely-allied plants—one scented and fertilised by bees, the other scentless and variegated, and

fertilised by very minute insects—is afforded by the Sweet Violet and the Pansy.

If attention is paid to the arrangement and position of the stigmas and stamens at the time when insects are seeking the flowers for the sake of the honey, it will be seen that the anthers are almost always at this time discharging their pollen, and that it is impossible for the insect to find its way to the nectary, or to insert its proboscis into it, without brushing against one or more of the anthers, and carrying away with it a portion of the pollen. Either in its retreat from the flower or in entering the next flower (of the same species) which it visits, it will also almost inevitably strike against the stigma and leave some of the pollen-grains behind on it, which will then put out their tubes and fertilise the ovules. But, inasmuch as in by far the majority of cases the stigma is not "receptive," or in that papillose and viscid condition in which alone it incites the emission of the pollen-tubes, at the same time that the pollen is being discharged from the anthers in the same individual flower, provision is thus made for that "cross-fertilisation" which we have already spoken of as the general rule; and, indeed, in many cases no other mode of fertilisation is possible.

Flower-arrangements for Cross-fertilisation.

Readers of botanical literature are now so familiar with illustrations of the infinite variety and beauty of the contrivances for the cross-fertilisation of flowers by insect agency, that we do not propose to give any more here. The simple arrangement by which the pistil and stamens in the same flower arrive at maturity at different times may be noticed without difficulty by the most careless observer. It is only necessary to gather the common Rib-grass (*Plantago lanceolata*) to observe that the feathery stigmas are produced from the still half-closed bud or before the stamens are nearly mature; and the same is the case with the waterside Figworts (*Scrophularia nodosa* and *aquatica*). The reverse, however, is far more common, and may be well seen in almost any plant belonging to the natural order Caryophyllaceæ,—as, for example, any of the common species of Stitchwort (*Stellaria Holostea* or *graminea*), where the anthers have actually dropped off the filament before the stigmas have acquired their receptive condition. The Harebell, or any other species of Campanula, wild or cultivated, will illustrate the same phenomenon. A singular circumstance

connected with these arrangements is, that closely-allied species of the same genus exhibit sometimes exactly opposite peculiarities in this respect; and it is even uncertain whether the same species does not vary under different conditions. A very interesting account of the phenomena presented by a number of plants of the Pea tribe belonging to the natural order Leguminosæ, by Mr T. H. Farrer, will be found in 'Nature,' vol. vi. We may give a single very good example of this in the two common Mallows. In the large Mallow (*Malva sylvestris*) the stamens are collected together into a bundle completely surrounding and overtopping the pistil. At a later stage the empty anthers are bent down out of the way of the stigmas, which are even yet not in a receptive condition. Spontaneous self-fertilisation is in this case scarcely possible. In the smaller species (*Malva rotundifolia*) the structure is the same up to a certain point, but the stigmas mature earlier, and when in this condition coil themselves among the anthers, there being still sufficient pollen left in the anthers to insure the self-fertilisation of the flower. The two species often grow intermixed; both are scentless; insects are, however, abundantly attracted by the large showy flowers of *M. sylvestris*, which are also beautifully streaked, the streaks all pointing towards the nectar-glands, at the base of the tube formed by the filaments. The flowers of *M. rotundifolia* are much smaller and of paler colour and are not streaked, and hence not so attractive to insects. Dr Müller records thirty-one species of insects, chiefly Hymenoptera, which he detected visiting the former, whilst only four were observed to frequent the latter species. *Dianthus deltoides*, the "Maiden Pink," is scentless; but each of the five petals is provided with a number of purple spots, which seem to indicate to the butterflies, by which they are chiefly visited, the exact place wherein to insert their proboscis in order to reach the honey glands. The anther, at this time discharging pollen, is placed immediately over each petal, and the butterfly cannot fail to carry off some of the dust on its head. A second inner row of five stamens, at this period completely concealed within the tube of the corolla, do not mature till later; and it is only after all the anthers have dropped off that the two stigmas, previously coiled round one another, separate and develop the hairs which serve for the detention of the pollen. While the various contrivances connected with the arrangements of the male and female organs have been more or less known to botanists for three-quarters of a century, very little attention has been paid,

until the publication in the present year of Prof. Müller's book already mentioned, to the corresponding adaptations of the structure of insects for the same purpose. This naturalist—an accomplished entomologist as well as botanist—has made this branch of the subject his special study, and has collected together a large number of interesting and curious facts.

Pollen removed by Insects in two ways.

There are two ways in which insects perform their part in fertilisation—in their search for honey and for pollen. Several instances occur of the mode in which insects, especially those furnished with a long proboscis and belonging to the orders Lepidoptera and Hymenoptera, involuntarily detach some of the pollen while obtaining their food, and carry it away with them to fructify other flowers which they then visit. One of the most interesting examples of this was first described in detail by Darwin in his work on the 'Fertilisation of Orchids;' and it is extremely easy to observe the manner in which the pollen-masses or "pollinia" of Orchids are carried away on the proboscis of butterflies and moths. The natural order Asclepiadaceæ, to which belong the beautiful waxen-flowered Hoya and the singular fœtid Stapelia, has the pollen arranged, in the same manner as in Orchids, in pollen-masses which are similarly fixed in pairs to a viscid base, the whole apparatus being easily detached on to any insect which visits the flower.

The second mode in which insects assist in the fertilisation of flowers is by the voluntary deportation of pollen; and this is chiefly effected by Hymenoptera belonging to the class Apidæ, which includes the hive and bumble bees, that build nests in which they store up large quantities of food for their young while in the larva state. This "bee-bread," as it is termed, with which the thighs of homeward-bound bees are seen to be heavily laden, consists almost entirely of innumerable pollen-grains robbed from the flowers, which the little depredators may be seen to despoil in a very scientific manner. Though the greater quantity of this pollen is carried home, small quantities of it are unintentionally left behind here and there on the stigmas of the flowers, quite sufficient to insure the fertilisation of the ovules. Prof. Müller arranges the different genera of Apidæ into a series according to their adaptation for this deportation of pollen, from the extent to which their thighs, shins, and feet are clothed with hairs.

Besides these, there is a third purpose for which insects

remove the pollen of flowers, which is less known, and the object of which in the vegetable economy is not so evident—viz., by acually eating it. This has chiefly been observed in the case of flies or Diptera belonging to the class Syrphidæ, the movements of which in summer and autumn, in hovering over flowers and then suddenly darting upon them, are so remarkable. Many entomologists doubt whether it is possible for flies, which have no mandibles, and whose only food-obtaining organ is a proboscis adapted for suction, to masticate so comparatively hard a substance as pollen-grains. This need not, however, present a difficulty to any one who has smarted under the irritating attacks of flies and midges during rainy weather in mountainous countries. We have ourselves dissected the bodies of flies belonging to this family, and found their stomachs in many cases perfectly loaded with pollen-grains. Prof. Müller takes this view very decidedly, and gives some admirable drawings to show the manner in which the extreme tip of the proboscis is furnished with a number of cross-bars, by means of which, as he has himself observed, these insects are able even to tear asunder the fine threads by which the grains of pollen are frequently attached to one another, as in the Evening Primrose. It is often a matter of surprise to the cultivators of flowers that many species which flower luxuriantly in our gardens never produce fruit or seed, though all the separate organs of the flower appear to be perfectly developed. This is the case, for instance, with the large white Convolvulus grown frequently against the walls of houses, and with the yellow Jessamine which flowers in the winter, and to a less extent with the Calycanthus or Allspice tree. The reason of this is, no doubt, generally the absence of those insects which serve as their fertilisers in their native country, our native species either not being attracted by their foreign nectar, or not possessing the mechanical appliances necessary to obtain it, and hence not visiting the flowers. We mentioned at the outset that, though the large majority of flowers are cross-fertilised, yet there are exceptions to the rule. Darwin has described the peculiar contrivance by which self-fertilisation is effected in the singular Bee-orchis (*Ophrys apifera*) of our chalk-hills, alone among our native Orchids. There are not a few flowers which never or scarcely ever completely open their petals so as to allow either the entrance of an insect or the escape of the pollen. An instance of this is furnished by the pretty little bog-plant the Sundew (*Drosera rotundifolia*).

"Cleistogamous" or self-fertilising Flowers.

The most singular, however, of these special contrivances for self-fertilisation are the peculiarly-shaped "cleistogamous" flowers, as they have been termed—which occur in many plants belonging to widely-separated natural orders, either intermixed with the ordinary conspicuous flowers or appearing at a different time of the year—with respect to which very little has been written in English botanical works. Among the natural orders in which these flowers have been found are Violaceæ, Cistaceæ, Oxalideæ, Balsamineæ, Polygalaceæ, Caryophyllaceæ, Malpighiaceæ, Leguminosæ, Campanulaceæ, Convolvulaceæ, Acanthaceæ, Labiatæ, and one order of Endogens, Commelynaceæ. The two species of Impatiens or Touch-me-not which grow wild in this country—*I. Noli-me-tangere*, native in Westmoreland and some other rocky and woody parts, and *I. fulva*, a North American plant fully naturalised by the banks of the Wey and other parts of Surrey, as well as the smaller *I. parviflora*, now also rapidly becoming completely naturalised in the neighbourhood of London—have closed, imperfect, self-fertilised flowers intermixed with the showy yellow ones. They are far more numerous than the conspicuous flowers, much smaller, and easily recognised even in the bud. The calyx is quite regular, not presenting the "spur" of the open flowers, always remains perfectly closed, and is pushed off at the extremity of the seed-vessel in the form of a little brown cap. The petals are entirely absent. The stamens are of an altogether different shape to those of the larger flowers, and contain but a very small quantity of pollen, which, however, is amply sufficient for the fertilisation of the ovules, the full number of seeds appearing to be always produced. The most easily observed instances are, however, in the case of our common wild Violets, the Sweet Violet (*Viola odorata*), or the various forms of the Dog Violet (*V. canina*). The existence of these flowers in Viola was known as long ago as the time of Linnæus, who, in his 'Prælectiones Botanicæ,' says that the flowers of *Viola mirabilis* produced in the spring are often barren; while the later ones, which have no corolla, are fertile. Von Mohl has seen the pollen escape from the anthers on to the stigmas, and give out abundance of pollen-tubes. Monnier says that the ordinary spring flowers of *Viola hirta* and *V. odorata* never produce seed; but this statement is disputed by others. The cleistogamous flowers of the Violet appear long after those

that are so familiar in the spring, and may be found in abundance about July and August, very small, but still not difficult to make out. On opening them there is no trace of petals; there are five stamens, with long filaments and very small anthers, offering scarcely any resemblance to those of the open flowers, which have very large anthers and no filaments. The pollen, again, very small in quantity, is contained in two almost transparent bags at the base of the anther, and is discharged directly on to the stigma. The pistil consists of a conical ovary, and a very large stigma curved completely over in a semicircle so as to bring the papillose receptive surface into a horizontal position in which it will most readily receive the pollen. A most instructive contrast is afforded between the arrangements of the reproductive organs in these two kinds of flowers on the same plant. In the showy spring flowers the stigma projects horizontally in the form of a beak above and quite clear of the stamens, the arrangement of which is such that it is scarcely possible for any of the pollen to reach the stigma without the intervention of insect agency. In the closed summer flowers it will be seen that the arrangements have evidently an exactly opposite purpose. They produce abundance of seed. Another section of the genus Viola, of which the wild Pansy (*Viola tricolor*) may be taken as a type, produces no cleistogamous flowers; and the contrivances for the fertilisation are, as has already been mentioned, quite different from those in the true Violet.

In two Indian species of Campanula, the closed flowers are described by Professor Oliver as being altogether different in shape to the conspicuous ones. They are covered by a completely-closed membrane, the rudiment of the corolla; the stamens are extended horizontally, and the anthers are quite connate, and together adnate to the stigma. As the flowers have only at present been observed in dried herbarium specimens, the mode in which the pollen-grains reach the stigma is still uncertain. In *Juncus bufonius* it is said that the pollen-tubes are emitted while still within the anther, the wall of which they pierce. In the Wood-sorrel, *Oxalis acetosella*, the closed flowers, which appear towards the end of the summer, resemble much more closely the well-known spring flowers, which are in this case certainly fertile. In accordance with the ordinary practice of economy by nature, the amount of pollen in the cleistogamous is generally very much less than in the open flowers, since it has very little chance of being wasted. In the small flowers of Malpighiaceæ, Jussieu states that there are only a very few grains of pollen; in those of

the wood-sorrel, where twenty to thirty ovules have to be fertilised, Von Mohl gives the quantity as from one to two dozen grains in each anther-cell; in Impatiens it is considerably larger; while in Viola the number of grains is very small. More detailed examination of these closed flowers in different plants will doubtless yield interesting and important results.*

* See the interesting papers by Hermann Muller contributed to 'Nature' during 1875, 1876. Also a series of illustrated papers from the pen of Dr Asa Gray, entitled "How Flowers are Fertilised," in which the various arrangements for securing or for preventing cross fertilisation are pointed out. These papers were published in the 'American Agriculturist' for 1876.

ARTIFICIAL FERTILISATION AND CROSS-BREEDING.

PURE HYBRIDISATION, OR CROSSING DISTINCT SPECIES OF PLANTS.*

THE following are the rules I observe and the means which I take to insure success in my experiments with reference to this subject:—

1st. I long held it to be of vital importance to have the separate plants intended for the parents in the cross, even though both were hardy, put under glass, and I still recommend it; for, by doing so, you heighten the temperature—an important thing—and you can better secure against the interference of winds and insects; and though Darwin holds the former of small account, I have reason for differing from him there. But in the height of summer, pollen may be taken from an outside plant to cross an inside one, and *vice versâ*. If the cross is to be made on an outside plant which cannot be conveniently removed, I cover it with a hand-glass or *cloche*.

2d. I hold it not enough merely to emasculate the intended seed-bearing flower; I take off every petal, for the petals attract the insects, which seem guided more by their optics than any sense of smell. This act of emasculation in some cases I perform long before the expansion of the bloom; for in many plants—*e.g.*, in the Papilionaceæ, some of the Rosaceæ, and Compositæ—self-fertilisation may, and does, often take place in the unopened flower. This is not all. I sometimes put a gauze bag over it; if I do not, the mutilated bloom may not escape that most troublesome of all insect pests, the humble-bee, which in his unwieldy flight may come across it

* By Isaac Anderson-Henry, Esq., F.L.S. A paper read before the Botanical Society of Edinburgh, and since revised and augmented. Reprinted by kind permission of the author. Interesting information on artificial fecundation will be found in the 'Revue Horticole,' 1868, p. 376; 1869, pp. 136, 260, 335, and 346; 1871, p. 390.

by pure accident. But for the most part now, I make clean work of it, and remove all other expanded flowers on the seed-bearing plant, and allow no kindred one to be near.

3d. Do not be in a hurry to effect your cross; wait till you find that the stigma is fully developed. In many plants this is shown by a glutinous exudation on the summit, as in the Ericaceæ, the Onagraceæ, &c. In other orders, such as the Geraniaceæ and Malvaceæ, it is indicated by the feathery expansion and recurvature of its separate divisions.

4th. The next thing is to obtain properly-ripened pollen-grains from the male plant. This is done by carefully watching when the anthers burst, otherwise the insects may be before you; and so active are they, especially on such favourite food as the pollen of the Rubus tribe, that, to get at it all, I have found it necessary to encase the opening blooms in muslin bags till the pollen was ripe and ready for use. Do not use, as is generally recommended, the camel-hair pencil, which, applied often and indiscriminately, may and often does convey, with the foreign, some insidious grains of native pollen, which, however few, are prepotent, and wholly neutralise the former. Take, where that can be obtained and afforded, the entire bloom of the intended male, and give the slightest brush with all its anthers over the stigma, or all the stigmas, if more than one, of the intended female. I will give my reasons for this by-and-by. You may use for experiment, in some cases the long, and in some the short, stamens. To those of the proper dimorphic form I have made some allusion elsewhere; they occur in the species of Primula, and in some of the species of the Linum tribe (as to both of which, see Darwin's most remarkable papers in the 'Proceedings of the Linnæan Society'). Such anthers, at least two long and two short ones, occur in the two orders of the Linnæan class Didynamia, on which I may have a suggestion to offer hereafter, for I think something interesting may be worked out of this form. In cases where the anthers are few, as in the Linnæan classes Diandria, Triandria, &c., you may use small pincers—a bit of wire so twisted as to form that implement, to carry in the pocket, is by far the handiest. I have used such an instrument all along, and find it better than any other form. In some tribes, the better to secure against invasion by insects, such especially as in some of the Rosaceæ having large discs, a muslin bag may be used, so as effectually to exclude them; I use it constantly in the Rubus tribe immediately after emasculation, taking it off and replacing it after the cross, and keeping it on thereafter till the cross has set.

5th. In some cases it is a matter of some difficulty to procure, and when procured of no less importance to preserve, pollen. In diœcious plants—say the Aucuba—a friend may have the male, and you have, as we all have, the female in abundance. You would like to store that pollen till your female plant, generally later, comes into flower. Many hold that pollen cannot be preserved in a vital condition for more than one or two, or perhaps three weeks. In a recent publication which refers to this matter—namely, Max Wichura's 'Observations on Hybridisation,' of which a very lucid abstract, carefully digested and translated from the original German by the Rev. M. J. Berkeley, is given in the January number of the 'Journal of the Royal Horticultural Society' for 1866, that eminent authority holds it as "a fact of great importance that the pollen of Willows retains its potency for some time. In some cases, pollen ten days old was efficient, while vitality was still further prolonged by steeping it in a solution of honey" (of which I have doubts). "Pollen," he adds, "of *Salix silesiaca* eight days old seemed almost as potent as ever; in twenty-eight days the traces of vitality were very slight, while that of the *Salix cinerea* had become weak in sixteen days." Now I am not aware that there is less vitality in the pollen of Willows than in that of any other family; and as many experimentalists hold kindred views to those here enunciated by Wichura, I deem it a matter of some importance to give you one or two instances of my own experience. I have carried in my pocket the pollen of Rhododendron again and again from six weeks to two months and upwards, and still found it potent. Of the Japanese forms of the genus Lilium I have kept pollen effective in the same manner for equal periods. In fact, generally speaking, I have found the pollen of most plants to remain good for similar periods. Having last year got the new and beautiful *Clematis Jackmanii* to flower, and anxious to preserve its pollen as long as possible, I collected and stored it in its anthers in a simple pill-box. On the 4th of July 1866, I so gathered and put it into a drawer of a cabinet in my own sitting-room, where it remained wholly away from damp. On the 5th of June 1867, having first carefully emasculated a flower of *Clematis candida*, I crossed it with the pollen, then eleven months old, and from this cross I have this autumn gathered and sown eight well-developed seeds. Now both parents are hybrids, with a large infusion of alien blood in them, so that here the vitality was put to its severest test. Subsequent experiments satisfy me that the vitality of all pollen may not be so long preserved, for I have

found that of the Aucuba inert after being stored about six weeks. But as some bits of stems had got mixed, these may, by inducing damp, have destroyed it. I would therefore recommend it to be brushed off pure and stored in silk-paper. I notice this result here (somewhat out of place) to suggest the propriety of storing, and, if needful, of importing pollen, which, if wrapt up in silk-paper, might even, enclosed in a letter, reach this country still potent, by the overland route from India, or after two or three months' voyage, from all parts of South and North America. Let collectors and friends in distant countries be instructed as to this, and we may soon have an improved progeny of the rarest things, even before such novelties from which they are derived have been obtained from their own seeds in this country.

6th. There is another matter of much consequence to be attended to in the crossing of distant species—I mean, the times and seasons for effecting the cross; yet not one of those most experienced in the art, from Darwin downward, has touched upon this point. It has been forced upon my attention for more than twenty years. I have found that I could, on some few propitious days which occur throughout the season, successfully effect crosses I could not effect with all my care at other times. I have adverted to this in the paper I formerly submitted to you, and I again refer to it. There are some crosses which I have effected at such times, and which I would have tried in vain to accomplish at times less favourable. If you have, say two plants of Rhododendron, one a tiny thing, to cross with a large species, or if you wish to attempt a cross between an Indian Azalea and a Rhododendron, watch for a propitious time. Such times occur, often few and far between, when there is less of sun than of that latent form of heat which frequently occurs before thunder, from the air being more than ordinarily charged with electricity. Or they may occur in the spring season, when there is much ozone present, whose influence I have often found to tell most favourably in promoting the germination of long-sown seeds. It was to the presence of ozone, or to some other form of electrical agency, I attributed the almost simultaneous germination of some New Zealand seeds of a shrub which I got from that country under the name of "Black Maupan," a species of Pittosporum, which sprang up together on the morning of the 16th March 1863, after they had lain dormant two years and eight months. Such atmospheric conditions, to whatever cause they may be due, I have found not unfrequently to occur with the east winds of March and April; at which times I have seen many other long-sown

seeds spring quite suddenly and unexpectedly. Seize upon all such seasons for difficult crosses. As to the time of the day, you may operate best perhaps from 10 A.M. till 6 P.M.

Appearances if the Cross has succeeded.—We shall suppose the cross now performed. Your next anxiety will naturally be to find out whether it has taken. Almost all experimenters have noticed that soon—I would say from six to ten days—an alteration is observed on the stigma and style. You will find the viscid matter on the former dried up, while the latter has begun to shrivel. You will naturally conclude that it is all right, and that the fertilising pollen has now passed down into the ovary; and in some cases you may be right. But these appearances are deceptive, especially if you find the style maintain an erect position. And singularly, as I now write, I find, on glancing at the 'Gardeners' Chronicle' of the 19th October 1867, that this state of matters had been observed last summer by the learned editor of that publication, and described in his leading article of that day. He there observes: "We have ourselves, in following some experiments on cross-breeding this season, noticed that the stigma becomes changed—withered, almost immediately after contact with the pollen, even if no perfect seeds be produced." Now that gentleman is quite right; but I did not note the withering effect to be just so immediate as he had observed it, though it might have been so in the Epilobium tribe, to which his experiments refer. Another effect I particularly noted last summer was, that in attempting to cross an Indian Azalea with a Rhododendron (which, however, in that instance failed), not only did the stigma and style decay, but the divisions of the calyx took on a purplish tint, and a honeyed secretion continued long to exude from the disc. Another still more misleading condition often arises, as is noticed in the same leading article of the 'Chronicle:' "The ovary will swell, the fruit will set, in some cases without any contact with the pollen at all, though of course no embryo is produced." Wichura has noticed the like result; and the following degrees of failure noted by him have so often occurred in my own experience, that I cannot do better than cite them in his own words, from the Rev. Mr Berkeley's translation already alluded to, which I only alter according to my own experience: 1st, The organs submitted to hybridisation (the stigma and style) soon wither, but do not in all cases soon fall off. 2d, The ovaries swell and ripen, but do *not* contain a trace of seed. 3d, The ovaries may seem filled (I say may seem partially filled), having in some instances the small protuberant swelling outside as if seeds were within, and yet no

seed be there. 4th, Seeds are present, but small, languid, and incapable of germination. 5th, Seeds apparently perfect are developed which do not germinate. 6th, Seeds which germinate, but the young plants are weak, and wither in a short time, dying off oftentimes after developing the seed-leaves. I have had all these conditions and results amply illustrated; and of the second of these results I had, last summer, mortifying proofs in a muling operation I tried, by fertilising a flower of the new *Arabis blepharophylla* with my still newer *Draba violacea*. The cross, to all appearance, had taken; the seed-vessel swelled better than the others where no experiment was made, and while the valves of the silicules of these last opened, and showed no trace of seed in them, the siliquas of the former remained closed, showing by outward development that two seeds were certainly within. But I found on opening the ripe seed-vessels that there was no perfect seed in the interior, but only an abortive production. While Wichura's accuracy in the above degrees of failure is consistent with what I have myself had ample experience of, I cannot, from like experience, endorse the views he has formed on some of his successful results. At page 72 of the above article in the 'Journal of the Royal Horticultural Society,' Mr Berkeley, commenting on Wichura's paper, observes: "Gaertner, indeed. supposes that in genera which are rich in species, there are some which have a prepotent influence when hybridising, so that in some hybrids the type either of the male or female prevails. Amongst the various hybrid Willows, though the genus is so rich in species, and so prone to hybridising, Wichura has never seen a prepotent type, and doubts Gaertner's statement, especially as he makes it in very qualified terms." Mr Berkeley very judiciously remarks that it is not very easy to determine, "by examination of types, whether a hybrid is more like the mother or father—the perfect distinction is subject in many cases to great difficulties, since very much depends on the subjective view of the observation; for, in consequence of the frequent intermelting of both characters, the one observer finds in a hybrid the maternal type, while another thinks the paternal type prevalent." By which I regard Mr Berkeley as very modestly dissenting from his author. And further on, at page 78 of the same Journal, Wichura speaks out still more absolutely. "When both parents," says he, "belong to the same species, we cannot tell what part the male and female parent take respectively in the formation of the progeny. But dissimilar factors are united in hybrids, and an intermediate form is the consequence. The products which arise from

the reciprocal crossing in plants, unlike those which are formed amongst animals, are perfectly alike." I regret to differ from so great an authority as Wichura, and must venture to demur to the doctrine in more decided terms than Mr Berkeley does. I have had so many instances of hybrids taking sometimes to one side and sometimes to another—but most frequently to that of the mother—that to those who, like myself, have made experiments with many genera, it would be needless to give instances. The converse is the rarer case—*i.e.*, where the paternal type comes out most marked. Yet I remember one eminent instance of a seedling Veronica, from the batch of seedlings from which I obtained *V. Andersonii* (*V. salicifolia*, *V. speciosa*), being so like the male parent *V. speciosa*, that I presented it to a friend in the belief that it was purely and simply the latter species; but when it bloomed, it showed, by the longer spike, and lighter and brighter colour of the flowers, and by their being a bright crimson instead of very deep purple, which is the colour of the flower of the *V. speciosa*, that the blood of the *V. salicifolia* was there. I can well understand that, as respects the family of Willows, from their being so attractive to bees, and from their being naturally so prone to intermix (insomuch that few can tell what is a species and what is a hybrid), Wichura has not much overstated the fact, and that a distinct intermediate form may generally be reckoned on.

I must dissent still more strongly from what Wichura lays down, in continuation of the above passage at page 78, as to reciprocal crossings. "The products," he says, "which arise from reciprocal crossing in plants, unlike those which are formed amongst animals, are perfectly alike.* It is of no consequence which is the male and which the female parent. It

* Mr Seden obtained exactly similar results by the reciprocal cross-fertilisation of *Cypripedium longifolium* and *C. Schlimii*, both having been made the female or seed-bearing parent, fecundated with pollen from the other, and the result was offspring of each precisely the same, two or three hundred seedlings having resulted from this double union, and these are now under cultivation under the name of *C. Sedenii*. This is a well-authenticated case, for the facts of which I am indebted to Mr Seden himself; and certainly goes to prove the observation of Wichura, who says, "The products which arise from the reciprocal crossing in plants, unlike those formed amongst animals, are perfectly alike."—(See *Datura*.) Some hybrid Aloes, raised at Kew by Mr R. I. Lynch, between *A. albocincta* and *A. grandidentata* are to all appearance exactly identical in habit and variegation, although the parent species are singularly unlike each other. These hybrids, as in the case of *Cypripedium Sedenii*, are the result of seeds saved from both the species, each having been crossed with pollen of the other.

is therefore a mathematical necessity that the pollen-cells must have just the same part in the act of generation as the ovules." And, based mainly on this doctrine, he follows up and amplifies it in a series of aphorisms which, he admits, are to be "considered conjectural, and require to be submitted to proof,"—an admission for which he is to be commended, and all the more if he submitted to the like test the dogma on which they mainly rest. It humbly appears to me that his statement had been suggested from his experience among the Salices—of all plants the most mongrel in a state of nature. Now, in all this, Wichura appears to me to imply that if a distinct intermediate may be formed, and is formed, by crossing A on B, so may an exactly similar intermediate be reciprocated by crossing B on A. And M. Naudin, in his experiments among the Daturas, enunciates the same belief, and holds "that there is not a sensible difference between reciprocal hybrids of two species." That distinguished observer, like Wichura, seems to have confined his experiments to herbaceous or soft-wooded plants. But, from a long and large experience among both hard and soft wooded plants, I demur, 1st, to the capability of the parents being in all cases made subject to such reciprocity; and, 2d, to the statement where such reciprocity does hold, that the progeny are perfectly alike, whether A or B supply the pollen.

In my various crossings I have experimented on many hard as well as soft wooded genera—in particular, I would here instance among the former the species of Rhododendron. In these I have again and again been baffled to reciprocate a cross which on one side was comparatively easy to be effected. When the lovely and fragrant *Rhododendron Edgeworthii* first bloomed in this country, all were eager to see its beauty and perfume transfused into dwarfer and hardier forms. Some tried the cross by making *R. Edgeworthii* the female or seed-bearer, others by making it the male. I tried it in both ways, but all my efforts failed where I attempted the cross on the *R. Edgeworthii*. But while it would not be brought to bear hybrid seed, I had no great difficulty in effecting a cross from its pollen on *R. ciliatum*, another of Dr Hooker's beautiful Sikkim species, having all the desirable requisites of hardihood, dwarf habit, and free-flowering tendency; and, singularly, just as I had obtained and sent off blooms of this brood to lay before the committee of the Horticultural Society of London, Messrs Veitch, of Chelsea, anticipated me in having a plant of this identical cross first exhibited before that committee, which is now well known and generally cultivated under the name of

Rhododendron "Princess Alice." Now, neither I nor any one who ever tried it, so far as I know, ever effected the *inverse* cross of *R. ciliatum* on *R. Edgeworthii*; and if they did, the progeny would long ere now have appeared in nursery catalogues. There is yet one other instance I may notice as an illustration of what I am now contending for. In my former paper I noticed, as an exception to a rule I had found almost general—viz., that European had great aversion to cross with Asiatic species—that I had, notwithstanding, effected such a hybrid by crossing *R. eleagnoides* (another of Dr Hooker's acquisitions, a tiny Sikkim species) on the European *R. hirsutum*, and of having sent the survivor of the two plants which came of it to Kew,—of which, by the way, Dr Hooker writes me, that it dwindled away and died after being a few years in their hands; but by no possible means could I invert that cross, or get that same very interesting tiny yellow-flowered species, *R. eleagnoides* (a form of *R. lepidotum*), to submit to a cross from any species whatever.

I shall now advert to the second point which Wichura lays down as a fact—viz., that the progeny of reciprocal crossing, whether it is A on B or B on A, are precisely alike. While my past experience goes with what I observed last summer, it may perhaps suffice to give the latest instance. Having, through the kindness of Dr Hooker, obtained seeds of a beautiful new Californian Arabis (*A. blepharophylla*) with large fine rose-tinted flowers, I felt desirous to infuse that colour into some of the other kinds I possessed. After trying it on several, especially on *A. albida*, in vain, I at last effected a cross—a reciprocal cross—between it and *A. Soyerii*, a white-flowered species from the Pyrenees, something like *A. albida*, but with glabrous foliage. Of the cross *A. Soyerii* on *A. blepharophylla* I have raised six plants, the product of two very largely developed seed-pods. These plants are alive and healthy, and promise an improved vigour over either parent. That the cross was sure I had the best proof, from there being no seeds in the normal pods of the seed-bearer. Of the inverse cross from one weakly seed-pod I raised one plant, which, after maintaining a sickly existence for some two months or so, has died off. But while this last cross was equally certain as the others, like it, the plant had more of the mother than the father in it. In fact, I have oftener found the maternal type most marked in hybrid progeny. I have various crosses effected between distinct species of Rhododendron, where, while the male manifests his presence, the female type prevails. I have it in *R. Jenkensii* crossed by *R. Edgeworthii*, *R.*

caucasicum by *R. cinnamomeum*, and the hybrid from this latter cross crossed again with *R. Edgeworthii*, and especially the Sikkim species *R. virgatum* crossed with another of my hybrids, *R. ciliatum* by *R. Edgeworthii*—all having more the foliage and the aspect of the mother than the father.

I have another hybrid of the same *R. virgatum*, the female parent crossed, I believe, by *Rhodothamnus chamæcistus*, a tiny procumbent plant of three inches, but all set with flower-buds —not, as in the male parent, at the tips of the shoots, but, as in the female, at the axils of the leaves. I have stated my belief that the Rhodothamnus is the male parent, but I cannot do so confidently, from the tallies having got into confusion—the specimens being planted out. But as some plants were obtained from that cross, and as this is the smallest, I regard it as likeliest to be the true progeny; and the cross being an extreme one—a mule, in fact—it is open to question. But as I have this season effected still more extreme—certainly more unlikely—crosses in that family, where there could be no miscarriage, you may, I think, take it as true in the meantime. I could overwhelm you with proof. Darwin, at page 333 of the last edition of his 'Origin of Species,' has observed the above tendency. "When two species," he says, "are crossed, one has sometimes a prepotent power of impressing its likeness on the hybrid; and so I believe it to be with varieties of plants."

Naturalists of the highest note—Gaertner, Kolreuter, Naudin, and Wichura—are far from being at one on the subject of variability, as Darwin has shown, especially as relates to crosses, 1st, between species and species; 2d, between species and varieties; 3d, between mongrel offspring. But this is a complex subject; and when such high authorities are not at one, and Darwin admits that he cannot reconcile them, it is manifest that the case is still open to further probation. In dealing with the views of Gaertner, to whose testimony he deservedly accords great value (page 331), Darwin says that Gaertner, whose strong wish "it was to draw a distinct line between species and varieties, could find very few, and, as it seems to me, quite unimportant, differences between the so-called hybrid offspring of species and the so-called mongrel offspring of varieties. And, on the other hand, they agree most closely in many important respects. The most important distinction is, that in the first generation mongrels are more variable than hybrids; but Gaertner admits that hybrids from species which have long been cultivated are often variable in the first generation; and I have myself seen striking instances of this fact. Gaertner further admits that hybrids between very closely allied

species are more variable than those from very distinct species, and this shows that the difference in the degree of variability graduates away. When mongrels and the more fertile hybrids are propagated for several generations, an extreme amount of variability in their offspring is notorious; but some few cases, both of hybrids and mongrels, long retaining uniformity of character could be given. The variability, however, in the successive generations of mongrels is, perhaps, greater than in hybrids." So reservedly does Darwin deal with a subject on which the opinions of others could be brought to bear; but as they are not all concurrent, and not unfrequently conflicting (which they may well be from the various subjects experimented on), he has said, with commendable moderation, all that can be said on the subject.

From my readers I respectfully claim the same kind indulgence which Darwin has shown to the testimony he has had to deal with in judging of the views I have offered and am now to offer on the experiments which I mean to lay before you. But ere I enter upon them it is necessary to premise, especially as regards that form of dimorphism which occurs among many plants in the Linnæan classes from Pentandria (5-stamened) up to Decandria (10-stamened)—in having very generally one if not two pairs of stamens shorter than the other stamens in the same flower, and the same dimorphic form often occurs in even a more marked degree in many plants of the class Tetrandria (4-stamened). It is also the distinctive character of the two orders of Didynamia to have two long and two short stamens. As described in my former paper, it is now seventeen years since my attention was drawn to the *long* and *short* stamens, but to the latter more particularly in muling operations I had performed, where by using them I crossed that large species of Rhododendron, *R. cinnamomeum*, on the pigmy *Rhodothamnus chamæcistus*. I refer to these short stamens again as the means by which I succeeded in effecting some extraordinary crosses, which I confidently believe but for their use and my improving a propitious time would have been utterly impracticable. As I have said, I at first worked only with short stamens; these I use in all cases where I wish to cross a large on a small species. I have now found that the converse holds good, and use the long stamens where I wish to cross a small on a large species. In all extremes I use the longest or shortest pair of stamens as the case demands. The short pair is generally well distanced by the others—the longest pair is often not just so much in advance. There is often an intermediate pair of short stamens, which in cases less extreme are exceedingly serviceable, but

there are seldom such intermediates among the long ones. My reason for the use of these short, intermediate, and long stamens is intelligible enough. If I wish to cross a large on a small species, the smallest-grained pollen being in the short stamens, I take the pollen of these stamens of the large plant as best fitted to pass down the tubes through the stigma to fertilise the ovules of the smaller species, and so effect the cross on it; and so, *cæteris paribus*, with respect to the other forms.

I shall restrict the instances I am now to cite to the last few years, noticing first—

Cases of Crossing with Short Stamens.

The first cross I shall notice is one already alluded to—viz., *Rhododendron virgatum* with my own hybrid Rhododendron B (*R. ciliatum* crossed on *R. Edgeworthii*); and as this cross is memorable and instructive in several points of view, it is proper to give you its history. On April 20, 1864, I find from my note-book that "I took off all expanded blooms of *R. virgatum* and removed the stamens from all unopened ones on the plant, there being none left for self-fertilisation; done in fine sunshine—west wind—with three short anthers of B"—*i.e.*, the hybrid male, being the identical cross which produced Veitch's Rhododendron, "Princess Alice." Of this cross I ripened four capsules of seed, which I sowed on January 28, 1865, and with some failures, got up by December that year seven nice healthy plants, all of which, however, save one, I lost by an accident. That one plant is now setting for bloom—not at the axils, as the female parent (*R. virgatum*) generally shows, but at the extremities of the shoots, as in the male (*R. ciliatum* crossed by *R. Edgeworthii*). But, as I have had occasion to observe already, the type in all else is more that of the female than of the male parent. By the mother's side this plant is a hybrid, by the father's it is a mongrel, and yet it has a fair share of vigour in it. As in its sexual aspect so in its height, it is that of the mother. A few cilia are noticeable on its leaves, but it has none of the tomentose or dense hairiness of the male parent; and so in this also it partakes most of the glabrous foliage of the mother. Again, this doubly-crossed plant, and the crosses which produced it—all extreme—show how such crossing may hasten on the reproductive or flowering state. Never in all my experience have I seen or heard of Rhododendrons offering bloom at two years of age. I have Rhododendrons now fifteen years from seed which have never shown the

slightest tendency that way, though ten and twelve years I would consider about the mean at which they attain their flowering condition. If by such crosses the like precocity can be generally secured, practical florists may turn them to some account in their profession. You will please observe that I am now dealing with hard-wooded shrubs, where there is in general more fixedness of structure and habit than in those on which the physiologists I have cited have chiefly experimented, and which are less liable to be modified by the manifold influences which affect the more pliant and shorter-lived herbaceous genera.

2d. The next cross in the Rhododendron tribe effected by the short stamens to which I would direct attention is very recent, and one with which I took the utmost pains to prevent miscarriage. The beautiful *R. jasminiflorum* of Java, with its delicious perfume and its long tubular five-lobed flowers, of snowy whiteness, so like *Erica Aitonii*—so like, too, in form and fragrance, the sweet-scented Jasmine—and so unlike all its own congeners, is the subject of it; and as I regard this cross as of some scientific as well as of some practical value, I shall offer no apology for giving you particulars. I made it the subject of many attempted crosses by many of its own tribe—all of which failed except two, which, by the way, afford a good illustration of what I alluded to in my former paper of the sympathies of plants, and perhaps, too, of natural selection, though whether it be in the mode which Darwin regards as leading to diversity of species I cannot positively assert, yet I think it is worthy of his consideration. While it rejected so many of its legitimate brethren of the Rhododendron tribe pure and simple, I was somewhat surprised that it took kindly with my hybrid B already noticed—*i.e.*, *R. ciliatum* crossed by *R. Edgeworthii*—a hybrid of the first degree, having large flowers of three inches diameter, perfumed, and also of snowy whiteness. After the bloom had been long emasculated, on April 17th, 1867, I effected the cross with the short anthers of the hybrid B. The cross took admirably—the seed-pod swelled, and was pulled fully ripe about 12th July last. On the 15th of that month I sowed the seeds. For the purpose of comparison, I sowed a pod of its own plain native seeds which I had gathered previously, and had, in fact, sown it some ten or twelve days before I sowed the cross. These are both now up. While the native seeds have produced a fair show of feeble plants, the crossed seeds have come up in more than double the number of plants, doubly vigorous in growth and habit, and with leaves so much larger than those of the normal form as to remove all doubt about the verity of the cross.

3d. The next illustration I have to give you is of a small-foliaged Indian Azalea, eighteen inches high, which I crossed with the tall and robust shaggy-foliaged *Rhododendron Edgeworthii.* Two things more unlike in every feature from which to effect a union can hardly be imagined. Yet, with the short anthers—and it was with the very shortest I could find on *R. Edgeworthii* that I effected it—the cross, after careful emasculation, was done on the 6th May last. The seed-pod swelled to its due dimensions, and, appearing to be ripe, I cut a slice off it, and sowed the seeds so early as the 13th, and the residue on 28th September last, and I have now got up one or two plants. If I shall be so lucky as to bring it to maturity, the progeny of this cross (one never before accomplished, perhaps) should be a sweet-scented Azalea, having a rose variegation like the female parent, a novelty in its tribe; for though the *Azalea sinensis* has been crossed by Rhododendrons, I am not aware of any authentic cross, or cross of any kind, between the Rhododendrons and this proper Indian Azalea.

4th. I have still further a cross of the same nature, between another Indian Azalea and *Rhododendron jasminiflorum*, the latter being again the seed-bearer; and I here refer to it mainly as showing another tendency of this Rhododendron towards natural sélection, or rather, perhaps, of sympathy between it and remote species, if not genera, for the Azaleas have till lately been regarded as a separate tribe from the Rhododendrons. The cross was effected in August last, when it again rejected its more natural allies, and formed a union with the Indian Azalea, a late rose-coloured spotted variety, a seedling of my own raising. The seed-pod of this cross is now at maturity.

5th. But I have now to call your attention to a cross in this same family bearing on Darwin's doctrine of natural selection, or of sympathy, in a still more remarkable manner, which I effected last summer between that most gorgeous of all the Rhododendron tribe—namely, the lovely white, large-flowering, sweet-scented *R. Aucklandi* of Dr Hooker, otherwise *R. Griffithii*—and an Indian Azalea, the latter being the seed-bearer. I made the cross on two separate days on two separate blooms, carefully emasculated some time before; and on the same Azalea I tried other crosses with several of the Rhododendron tribe—viz., with a fine form of *R. arboreum*, *R. Edgeworthii* pure, and the above hybrid seedling B (*R. ciliatum* × *R. Edgeworthii*). But while every one of these failed, the crosses by *R. Aucklandi*, which were effected respectively on the 30th April and 1st May, took most kindly. Both pods swelled; and the seed-pods, though green, appeared to be sufficiently

ripe when I pulled them. I counted the seeds in one of these pods, and found them to be about 324, all finely formed, but, I fear, too green to vegetate freely, though some which I sowed appear to be coming up. I cannot vouch for this cross being effected with the shortest stamens, for the stamens with which I effected it were kindly sent to me from another source, as I did not myself possess the male plant; but as I invariably select the shortest for such crosses, my firm belief is that I had so selected these in this instance, and I had a plentiful supply of all lengths to choose from. In the above cases of crossing a small with a large species, I hold firmly by the opinion that but for the use of the short stamens I could not have succeeded. I have few recorded instances of having extended my experiments with them far into other families. I certainly tried the Pelargonium in a plant I had of the beautiful white-flowered Madame Vaucher. I fertilised a bloom with its two shortest stamens, which, however, were very little shorter than the remaining ones; and, from the three seeds which came of it I raised two fine plants, far more compact and somewhat dwarfer in habit than the parent, having the flowers equally fine, and elegantly thrown up above the plant. But the short stamens of this section of the Geraniaceæ are very little shorter than the others, and I therefore cannot rely much on the results as establishing the hypothesis I contended for in my former paper—namely, that where all other things are equal, a cross or simple fertilisation with the short stamens tends to dwarf the progeny—to my belief in which, however, I still adhere. The instances I have given support this other hypothesis, that by their use you may cross a large on a small kindred species—a result which, without them, you might not effect.

Crossing with Long Stamens.

I have made fewer experiments with the long stamens, but I have one before me now no less remarkable, perhaps, for its far-reaching result than any I have alluded to as done with the short stamens. It is a cross which I effected on the tall *Rhododendron formosum*, fertilised with a scarlet-flowered Indian Azalea, on the 11th June last. The seed-pod is finely developed, but I have taken care in this instance to avoid pulling it too early. And I may here notice, once for all, that to obtain the seeds of a cross—especially if it be extreme—sufficiently ripe, you must allow a longer time for it than for the ripening of the normal seeds on the same plant.

In all the foregoing crosses I had, perhaps, less an eye to accomplish a purely scientific experiment than to effect a beneficial result; for, after all, it is the *quid sit utile* which those for whom this paper is mainly intended will have most in view; and, in my estimation, science is best promoted when she is made to minister to some useful end.

The following experiment among the species Clematis illustrates my view of sympathy as well as of antipathy, and, I would add, of unnatural selection: Having many years ago (long before the Messrs Jackman, who have accomplished such wonderful results) been myself working on the members of this genus, I thought of making another experiment on it, with a view to infuse a richer colour into a new and larger-flowering progeny; and, as I have observed already, I managed successfully to cross with pollen, kept for eleven months, the beautiful four-petalled *Clematis Jackmanni* on a thirteen-petalled flower of the fine *C. candida.* But it is of a cross on Messrs Jackman's smaller but no less beautiful *C. rubro violacea* I am now to speak. Though, like its congener *C. Jackmanni,* it sometimes comes with five or even six petals, it is in its general type a four-petalled flower. With a view to improve it in this feature, I crossed it also with pollen of the large-flowered *Clematis candida,* taken from a bloom having seventeen petals, though this Clematis—a French hybrid, I believe, from *C. lanuginosa*—is in its normal state a six or eight petalled flower. Though I crossed two flowers, after careful emasculation, I only gathered three seeds, but these all of unusually large dimensions. After the cross had taken, I left the normal blooms on the crossed plant to their fate; and though visited by insects innumerable, and though the native pollen was abundant, not one native seed, or any except the three produced by the cross, were ever formed on the plant; and the singular thing was, that with its own native pollen, abortive on itself, I successfully crossed the fine double white-flowered Chinese *C. Fortunei;* and a cross more prolific in the seeds it yielded I have not seen in the tribe before. I know not the parentage from whence this *C. rubro-violacea* was derived, though I believe it to be a mongrel with none of the *Fortunei* blood in it; yet mark how kindly the latter took with it—another instance of remarkable sympathy. Although I have no record of it, I think I failed to get *C. rubro-violacea* to reciprocate this cross.

In all these instances of sympathy and antipathy, and especially in this section of the natural order *Ranunculaceæ*, there is something apparently so inexplicable that I can only concur

with what Darwin has observed in his paper on the existence of two forms in the genus Linum, where, in summing up the good gained by the inevitable crossing of the dimorphic flowers, and numerous other analogous facts, he says that these all lead to the conclusion that some "unknown law of nature is here dimly indicated to us." And this law, when discovered, may disclose more mysteries, tending, perhaps, to the wider divergence of species, with constitutions and habits better fitted for the climates and localities in which they may be cast, as well as for subserving the purposes they are intended to fulfil in the economy of nature. In looking at *Ranunculaceæ*, with their innumerable male and female organs (and the same thing occurs in the *Myrtaceæ*, most of the *Rosaceæ*, some of the *Hypericaceæ*, and in many other families and tribes), the idea was long ago suggested to me, that each separate row, from the outer to the inner circle of the stamens, might have some separate function, just as I believe that the long and short stamens have their separate functions; and with the view of testing the matter, I had last summer begun experiments with these outer and inner stamens; but, other aims and objects interfering, I gave up the experiment after I had begun it on these Clematises.

But to make success certain, it is my custom, as I have already stated, in crossing any of these polyandrous flowers, to take the entire bloom of one kind, and lightly to brush over, with all its anthers, the stigmas of the flower to be crossed, and leave nature to make her own selection. In referring to the Rubus tribe and its species, I am reminded of an intention I expressed in my former paper of perhaps returning to them afterwards. I again experimented upon them last summer. But though I tried various crosses among them, and reciprocated the cross, I had no success in any, except between the *R. biflorus* and the *R. Idæus*, and that only where I made the latter the seed-bearer. And to make sure of either event—success or failure—I had the *R. Idæus* early potted and put under glass, emasculating every bloom I meant to cross; and for more security I stripped off all other flowers—nay, more, I put the emasculated flowers under fine gauze bags, to ward off the invasion of insects. When ripe for crossing I removed the bag, and, on effecting the cross, I replaced it. In this way I succeeded in ripening three berries of the cross *R. Idæus* by *R. biflorus*, of which I sowed the seed between the 5th and 16th July, though as yet none have vegetated. But *R. biflorus* stubbornly rejected a reciprocal cross. Again I tried both of these on *R. rupestris*, and the latter on them; and though *R.*

rupestris showed some sympathy with *R. biflorus*, in a slight tendency to form seeds, these came to nothing. In all these attempts I applied, as I have said, all the anthers of the male flower.

I cannot quit this part of the subject without offering some additional suggestions to those who wish to act on any hints I have it in my power to give:—

1st. If your desire be to hasten the flowering condition of plants, I recommend you to cross violently—*i.e.*, where the allies are not too near akin, and above all, in the case of mongrels; for nature, ere she gives up, ever makes a violent effort to reproduce.

2d. If you wish to make your hybrid flower more freely, as well as early, adopt the same advice.

3d. By following it, you will find that you have attained a further advantage. Your plant will remain longer in bloom, because most mongrels, especially those among herbaceous or soft-wooded plants, to which these suggestions apply, are impotent to produce seed, or nearly so, and in such cases the blooms remain long upon the plant. I have another idea, not sufficiently tested, however, in reference to the first point among hard-wooded as well as soft-wooded plants, that all such as ripen their seeds more quickly than others (some among the Rhododendron tribe ripen seed in half the time that others take) will reach more quickly their flowering state.

Lastly, as to fruits—on which, however, I have only partially tried my hand—I entertain the belief that we are on the eve of a revolution, and that by judicious and persevering crossing we may not only transfer the delicious aroma of one to another, and communicate hardier and more abundant bearing habits to the hybrid progeny, but further, especially in stone-fruits, such as Peaches, Plums, Apricots, &c., we may, in addition to these advantages, increase the size of the fruits and diminish the size of the stones; and, among vines, get rid of, or greatly diminish, the number of the seeds. And all this I hold to arise from that law of nature by which she not merely strains her efforts to reproduce (to which, however, she has assigned limit), but extends it when these have failed to make provision for her creatures' want. These views gather strength from what has been already done; and I may especially allude to what Mr Standish of Ascot has achieved among Grapes, of whose extraordinary results an interesting account is given at p. 135 of the 'Journal of the Royal Horticultural Society' for July 1866.

In conclusion, permit me to observe that, while my aim has

been, in all the experiments I have brought before you, rather to achieve something useful and practical than to test the theories which Mr Darwin and others—especially the Continental *savants*—have been so much engrossed with, I cannot refrain from making some remarks on the results and the conclusions which some of them have come to while prosecuting a series of crossing operations—namely, that such crosses do and must eventuate in sterility. M. Naudin seems, like Wichura, as already observed, to have limited his experiments chiefly to herbaceous or soft-wooded plants; and among such, especially among Calceolarias, I too have often found myself brought to the terminus of bitter and hopeless sterility. I remember one instance where I had reached a perfect monster for size in that tribe, but except in that particular it had no other desirable property. Determined, however, to improve it by crossing, I found on trial I could make nothing of it; and on examination I found its stigma was a hollow tube, and that its anthers were hard masses, and contained not one particle of pollen. Man may run into such mistakes, but he cannot thence conclude that unviolated nature does so. Speaking from a general recollection, which does not admit of my specifying instances, I have often found among hybrid seedlings some of a vigour which, in that respect, were in advance of either parent. May not such often occur in nature? and, as a naturally-selected parent becomes the progenitor of a hardier and more vigorous race (which having in it, according to Darwin's views, a tendency to diverge), may it not culminate in the long lapse of time into a distinct species, and even annihilate the weaker one which gave it being? So that, in nature's crossing, may not fertility and vigour take the place of sterility and weakness, into which she so generally dwindles when modified by man's device? *

* Those interested in hybridisation will find numerous experiments with Willows, &c., recorded in a German work, 'Die Bastardbefuschtung im Pflanzenreich erlautert an den Bastarden der Weiden;' Von Max Wichura, mit Zwei Tapeln (4to—Breslau, 1865). An interesting abstract from this work, by the Rev. M. J. Berkeley, is published in the 'Jour. Royal Hort. Soc.' (new series), i. 57.

GENERAL REVIEW OF SOME OF THE MOST POPULAR GROUPS OF CULTIVATED PLANTS, WITH NOTES ON THEIR PROPAGATION AND NATURAL AFFINITIES.

THE ACANTHUS FAMILY (*Acanthaceæ*).

A group of herbaceous plants or shrubs, chiefly natives of warm countries, and represented in our gardens by species of *Thunbergia*, *Meyenia*, *Hexacentris*, *Gymnostachyum*, *Ruellia*, *Goldfussia*, *Strobilanthes*, *Acanthus*, *Aphelandra*, *Thyrsacanthus*, *Graptophyllum*, *Cyrtanthera*, *Sericographis*, *Justicia*, *Eranthemum*, *Libonia*, and others scarcely less beautiful. Nearly all the hard-wooded species are easily propagated by inserting cuttings of the partially-hardened young growth in heat; and owing to the erect and branchless character of their growth, many species of *Justicia*, *Aphelandra*, *Thyrsacanthus*, *Graptophyllum*, &c., are best struck afresh every autumn or spring, otherwise the plants get leggy and unmanageable. *Aphelandra aurantiaca*, and its brilliant scarlet form *A. Roezlii*, are best propagated by seeds sown on a pan of light sandy soil as soon as ripe, and placed on a genial bottom-heat of 70° to 75°. Seeds are freely produced by many species; and in order to facilitate their production, artificial fertilisation is to be recommended. The Grecian and South European forms of *Acanthus*, remarkable for their glossy and handsome foliage, are propagated either by seeds, root-cuttings, or division. The pollen-grains of some Acanthads are very beautifully tuberculate, and look like burnished nuggets of fine gold when seen under a high magnifier.

Acanthus.—This is a noble family of plants, some of the species being found in most gardens, where they are grown for the sake of their massive, glossy green, and picturesquely-cut foliage. *A. spinosus* and *A. mollis* are natives of the south of Europe; and a tuft of the first-named species accidentally growing around a vase is said to have given Callimachus the

idea of decorating the capitals of pillars with carved stone ornaments representing its foliage—hence its use in Corinthian architecture. Most of the species are propagated by seeds, or by dividing strong established clumps. Sow the seeds in a pan of moist earth and place them in a cool pit or frame to germinate. Root-cuttings succeed tolerably well in heat.

Among herbaceous and border plants worth growing for the indoor decoration of apartments we may direct attention to the hybrid forms of Acanthus, such as *A. candelabrum*, *A. hybridus*, and *A. longifolius*. These have elegantly-cut foliage of a fresh green colour, and form excellent substitutes for the more tender Ferns and Palms.

These and several other hybrids have been raised in French gardens, and retain their foliage much later than *A. mollis* and *A. spinosus*, from which they have in part been raised. *A. latifolius* is one of the freshest and most stately of these varieties, and is a seedling from *A. mollis.*

Libonia.—A small genus of Brazilian stove or warm greenhouse shrubs—one species, *L. floribunda*, having become tolerably common in our gardens as a decorative winter-blooming plant. Easily propagated by cuttings of the young wood or by seeds, which are obtainable by careful fecundation. Seeds should be sown as soon as ripe in a genial bottom-heat of 65° to 75°. They soon vegetate, and should then be placed on a shelf near the light and carefully watered, as they are liable to damp off.

We have two remarkable hybrids (bigeners) which have been obtained by fertilising *Libonia floribunda* with pollen from *Sericographis Ghiesbreghtiana*, both well-known winter-flowering plants. M. André has followed Professor Oliver and Dr Masters in his method of naming these bigeners, and has described them under the compound generic name *Sericobonia.*

S. Penrhosiensis, Ed. André (Libonia Penrhosiensis, Hort. Bull.), was raised at Penrhose Castle a year or two ago, and is a dwarf-growing plant of rather dense habit, having ovate, deep-green leaves and trifasciculate clusters of *Libonia*-like flowers. Externally, this hybrid, although the produce of the same parents, differs materially in habit from the following, although in the floral structure of both there is an evident mixture of the generic distinctions of the parent species. The dwarf habit, leathery foliage, and smaller and redder flowers, distinguish it at a glance.—(See 'L'Ill. Hort.,' 1875, p. 64).

S. ignea, Lind. et André (see 'L'Ill. Hort.,' 1875, p. 39).—This is a taller-growing plant of more vigorous habit than the last, bearing large panicles of yellow tubular flowers suffused

with orange and red; and the ovate lance-shaped leaves with decurrent petioles afford a further distinctive mark. This plant was raised by Mr H. Rowland. It is interesting to observe that both these hybrid plants incline more to the male parent than to the female one (*Libonia*). Indeed, the evidence of the prepotence of the male parent is now wellnigh overwhelming; but a series of carefully-conducted reciprocal crosses is needed to set the question at rest, since, as pointed out by Dr Lindley long ago, much of this supposed sexual prepotence may be ascribed to constitutional vigour—that parent which has the strongest characteristics or fixity of character being able to influence the offspring most. We have here two bigeneric hybrid plants, both of better habit and of more value for decorative purposes than either of their parents; and it would be interesting to know whether they are capable of bearing fertile seeds or potent pollen, as in either case they might be again crossed with one of their parents, or perhaps even with another species or genus, as *Thyrsacanthus*, and a new race of fertile hybrids thus obtained.

THE MAPLE FAMILY (*Aceraceæ*).

A group of European, Indian, American, and Japanese trees, all more or less ornamental, and now included in the genus *Acer*. They are readily distinguished by their palmate or 5-7-lobed leaves and samaroid fruit. Each winged fruit bears two seeds, the coats of which are very thin — almost membranous, in fact; and the seeds are surrounded by a soft layer of silky hairs, which line the inner part of the pericarp. The seeds are nearly all embryo; and, curiously enough, the radicle and folded cotyledons are quite green, although they are entirely destitute of light from the time the leathery pericarp commences to harden. The seeds of Seakale also contain a large green embryo—a perfect plant with green seed-leaves, in fact; but in this last case the covering of the seed is green and succulent, and the embryo is enveloped in a slightly viscid fluid. Seeds like these—indeed all others which have no albumen and large embryos, such as Leguminosæ plants, &c.—should be sown as soon as ripe where practicable, or at the latest the spring following their period of ripening.

Acer (*Maples*).—A noble group of ornamental, round-headed trees, very useful in producing landscape effects, their foliage assuming various tints of yellow, brown, and red in the autumn, while in the months of April and May the young foliage is of a

very pale or tender yellowish-green tint. The Norway Maple, *A. platanoides*, and the Montpelier Maple, *A. monspessulanum*, are very bright and attractive in the spring when covered with clusters of golden-green flowers; and even the common wild Maple, *A. campestre*, is a lovely many-coloured tree when stained with the foliage of the waning year. The Negundo, or Ash-leaved Maple (*A. Negundo*), forms a very attractive specimen; while its variegated variety is one of the most attractive of all hardy trees, its snowy-splashed leaves contrasting most effectively with the deeper-toned foliage of the purple or copper-leaved Beech, or with the glossy deep-green Yews, Portugal Laurels, and other inhabitants of the shrubbery border. There are also some very attractive golden-leaved forms of the common Maple; and these and the white-leaved Negundo are worked on their respective green-leaved types as a stock, for which purpose they are readily multiplied either from seeds, layers, or cuttings, the two former methods being preferable and most generally practised The cut-leaved or purple Japanese Maples (*A dissectum*) are very attractive foliage-plants, although not thoroughly hardy, and may be readily increased by layering, budding, or grafting on the stem or roots of one of the commoner and strong-growing forms of the same species as a stock. Mr Rivers recommends budding on *A. palmatum* as a stock for this group Nearly all the hardy species produce their "keys," or winged seeds, freely, and these should be gathered in October and sown in prepared seed-beds in the open air at once Many of the species will grow on the common Maple as a stock, and may either be flute or cleft grafted in the spring or budded in the early summer. It is a curious fact that the recently-discovered *A. ginnala*, a native of Amooria, does not succeed when grafted on *A. tartaricum*, which is nevertheless so closely allied to it that some botanists regard the two as forms of one species. It succeeds perfectly on the common *A. pseudo-platanus* as a stock. The Sugar-Maple (*A. saccharinum*) is utilised in America and Canada, its juice or sap, which is obtained in large quantities by tapping the trees in early spring, being evaporated for the sugar it contains. From two to four pounds of sugar are obtained from a full-sized tree every year; for it is a singular fact that the operation does not appear to injure the trees, which are frequently tapped every spring for thirty or forty years in succession. The old gnarled or knotted stems of *A. campestre*, *A. saccharinum* (Bird's-eye Maple wood of the cabinetmakers), and *A. rubrum* (curled Maple wood) are highly prized for the manufacture of ornamental furniture.

THE COCKSCOMB FAMILY (*Amarantaceæ*).

Herbaceous plants or annuals, rarely shrubs, principally natives of tropical Asia and America, a few being found in Africa and New Holland. They are represented in our gardens by different species and varieties of *Celosia*, *Amarantus*, *Hablitzia*, *Trichinium*, *Achyranthes*, *Iresine*, *Gomphrena*, *Alternanthera*, and a few others less well known. Of these, *Celosia pyramidalis*, and the crested forms or "Cockscombs" *Amarantus* (Love - lies - Bleeding and Prince's Feathers) and *Gomphrena*, seed freely, and the seed sown in heat in spring germinates readily like other tender annuals. *Trichinium Manglesii* is a pretty little plant from the Swan River, which also bears fertile seeds; but it is most rapidly increased by cutting up the root-stocks into short pieces, which are then planted in light soil and placed on a genial bottom-heat to incite their latent buds to break. *Alternanthera* and *Iresine* have of late years become extremely popular in "carpet bedding," and cuttings of the young growth strike root readily in heat during the spring months. *Celosia pyramidalis* is one of the most valuable of all autumn-blooming decorative plants, its elegant plumes being of all shades of crimson, yellow, orange, carmine, magenta, lilac, lake and bright purple, the brilliancy of their colours being most remarkable. The varieties of this plant are generally raised from seeds, but the small lateral shoots may be taken off and struck in heat as cuttings either in summer or in the spring with excellent results.

THE AMARYLLIS AND KNIGHT'S STAR LILY FAMILY (*Amaryllidaceæ*).

Two of the most beautiful orders of endogenous plants are certainly Amaryllidaceæ and Liliaceæ, which have very many points in common, but may be easily defined by the position of the ovary or seed-vessel, which is outside (inferior) the floral envelopes or flower-tube in Amaryllids, and inside (superior) the flower in all true Lilies. To this order belong many of the most lovely of all garden plants, including the Snowdrops and Narcissi of Europe, the Pancratinums and Crinums of the W. Indies, the gorgeous Hippeastrums of Brazil, and the many beautiful forms of *Hæmanthus*, *Clivia*, *Cyrtanthus*, &c., of the Cape flora, and the

stately massive-leaved Agaves of Mexico. Nearly all are bulbous plants, readily propagated by offsets, suckers, or seeds, which are very freely produced. Fourcroyas, a rather distinct section of Agaveæ, rarely seed, but produce large quantities of fleshy bulbils on their flower-stems, which soon form plants when placed on moist soil. Seeds germinate very readily if sown as soon as ripe in pans of moist rich earth and placed on a gentle bottom-heat of 65° to 70°. *Valotta purpurea* is one of the most brilliant decorative plants in the order, and is nearly hardy, being often grown in cottage windows under the popular name of Scarborough Lily. Seedlings from it have often been raised, but they are remarkably constant in character. This plant will not cross with *Hippeastrum* or *Amaryllis*, but might possibly be induced to do so with *Cyrtanthus* or *Gastronema*. It may not be impossible to hope for hybrids between *Doryanthes* and *Fourcroya* or *Agave;* at any rate, if pollen can be procured the union is worth attempting. *Doryanthes excelsa* is a noble, scarlet flowered Amaryllid from New Holland (see Bot. Mag., t. 1684-85) *Eucharis* is lovely enough at present, but one may be excused for desiring hybrids (if they can be procured) between that genus and some other of the Pancratiform Amaryllids. The hardy Crinums —that is, the crosses between *C. capense* and other species—might be improved in vigour by again crossing them with *C. longiflorum*, another hardy Cape species bearing handsome purple flowers; and among the fifty or sixty species of *Crinum* already known, and at one time or other introduced to our gardens, there is ample room for intelligent hybridisation. What glorious masses of bright green leaves and fragrant Lily-like flowers these plants would give us if we boldly planted them out in the deep rich borders of our conservatories instead of starving them in pots! The following are the principal cultivated genera in this beautiful group: *Galanthus* (Snowdrops), *Leucojum* (Snowflakes), *Acis*, *Bravoa*, *Sternbergia*, *Amaryllis*, *Zephyranthes*, *Hippeastrum*, *Valotta*, *Nerine*, *Brunsvigia*, *Griffinia*, *Crinum*, *Hæmanthus*, *Cyrtanthus*, *Gastronema*, *Eurycles*, *Calostemma*, *Urceolina*, *Coburgia*, *Stenomesson*, *Pancratium*, *Ismene*, *Narcissus*, *Alstrœmeria*, *Bomarea*, *Clivia*, *Doryanthes*, *Agave*, and *Fourcroya*.

Acis.—A small genus of dwarf-growing hardy Amaryllids nearly related to the Snowflakes (*Leucojum*). They are natives of Northern Africa and the South of Europe, and are represented in our gardens by *A. rosea*, *A. autumnalis*, and *A. grandiflora*. They are easily multiplied by dividing established clumps or masses; or seeds which are freely produced

in warm sheltered situations grow freely if sown *as soon as ripe* in pots or pans of sandy soil, and protected in a pit or frame from which frost is excluded; for although the plants are hardy, the young seedlings are very tender in their earlier stages, and suffer much from damp or cold rains.

Agave (American Aloes).—A noble and extensive genus of succulent Amaryllidaceous plants, natives of South America, a large proportion of the species being natives of Mexico. The common *A. americana* and its variegated-leaved forms are well-known representatives of this genus in gardens. In Mexico, Agaves are commonly planted in rows, so as to form impenetrable fences. A tough fibre is produced by the macerated leaves, and is largely used in rope and paper making. The expressed juice of the leaves is used in soap-making, and several varieties of intoxicating liquors are made of it by fermentation. About 100 species are known in our gardens, some seedling forms of these—as *A. Verschaffeltii*, *A. Besserriana*, and *A. horrida*, for example—being extremely variable. The best private collection in this country is that formed by J. T. Peacock, Esq., Sudbury House, Hammersmith, and the genus is well represented in the botanic collection at Kew. As a rule, the species are readily propagated by offsets, which are in many cases freely produced, especially after the parent plant has bloomed; and in some cases offsets are produced on the flower-stem. Seeds are freely produced, and hybrids may be obtained by artificial fertilisation. As we have said, Agaves bear seed freely even in cultivation; and these seedlings vary so much in vigour, and even in habit of growth, that it would be interesting to make a series of careful experiments to see whether the quantity of pollen placed on the stigma influences the vigour of the resulting seedlings in any way. When I was in the Royal Gardens at Kew, several Agaves of the spicate group produced flower-spikes, the flowers of which are arranged in pairs spirally around the central stem. The lower flowers open first; and so far as my observation went, they are not fertilised by their own pollen, the style not being perfectly developed at the time its attendant anthers shed their pollen; but after these have shed their pollen, and hang limp and lifeless, the stigma has attained its full length, the swollen apex is viscid, and it becomes fertilised by pollen which is shed by the flowers now open above. A most copious supply of pollen is afforded by these plants; and although they do not need the agency of insects to assist in their nuptials, their aid is nevertheless generally forthcoming, even in a state of cultivation, owing to the ample feast of nectar

afforded by the tubular flowers. As we have said, the flowers open in gradual succession from the bottom of the flower-spikes upwards, and the section of the stem for five or six inches, where it is occupied by fully-expanded flowers, resembles a bottle-brush more than anything else, the anthers sticking out quite thickly in all directions; and it is an amusing sight to see flies, bees, wasps, ants, and at night cockroaches (*Blatta orientalis*), struggling through the pollen-laden stamens in their attempts to obtain honey from the flower-tubes. Old plants may be renovated by cutting the plant off at the collar, after which set the decapitated plant on a pot or tube of fresh compost, and it will soon throw out new roots. Seeds may be sown as soon as they are ripe in a pan of moist rich earth, after which place them on a shelf near the glass and water carefully. Seedling plants vary very much even if the parent plant has been fertilised with its own pollen. One or two garden hybrids have been obtained.

A. Taylorii.—This beautiful and distinct hybrid is the result of a cross between *A. geminiflora* and *A. densiflora*, and was obtained by Mr Taylor, who is so well known in connection with the celebrated collection of Cycadaceous plants at Lauderdale House, Highgate. It was sent out by Mr B. S. Williams in 1874. *A. perbella* is another distinct hybrid the origin of which is known, it having been raised by M. Kerchove at Vaslau, near Ghent. It is the result of a cross between *A. Xylacantha* and *A. univittata*, and was sent out by M. de Smet.

Alstrœmeria.—A very showy genus of very variable ornamental plants, having fascicled or bundled fleshy roots, reversed or resupinate leaves, and yellow, red, or greenish Gladiolus-like flowers. They are readily propagated by dividing the flesh-roots or crowns. Seeds are freely produced on warm rich soils, and germinate readily if sown as soon as ripe, or in the spring in light rich soil and placed in a gentle bottom-heat, or in a cool frame in April or May. Seedlings are remarkable for their great variety, and all the so-called species very closely resemble each other. They are natives of South America, and it would be interesting to know if they are variable in their native habitats. About 1841-42, M. Van Houtte raised numerous seedling and hybrid varieties, some of the latter being raised from *A. Hookeri* fertilised with pollen from *A. hæmantha*. *A. chilensis* has produced some fine forms by being crossed with pollen of other varieties. *A. Errenbaulti* is a Continental hybrid, said to have been obtained by fertilising *A. pelegrina* with pollen from *A. pulchra*. This variety is beautifully spotted,

and is further remarkable as its anthers contain no fertile pollen, although apparently well formed.

A. hæmantha, *A. aurea*, *A. pulchella*, *A. versicolor*, *A. Hookeri*, and *A. chilensis* have produced numerous forms, and their representatives are now grown in our best gardens, they being perfectly hardy on warm well-drained soils. One of the oldest of the cultivated species is *A. pelegrina*. Linnæus first received seeds of this plant from Peru, and it was grown at Kew so early as 1753. (See 'Bot. Mag.,' t. 139).

Amaryllis.—A showy genus of Cape bulbs, represented in our gardens by *A. Belladonna*, *A. blanda*, *A. pallida*, *A. (Brunsvigia) grandiflora*, *A. Josephine*, and others. The two last-named plants have produced fertile seeds crossed with *A. blanda*, although very distinct in habit The habit of Amaryllis is to flower in autumn before the appearance of the leaves, and this is a great drawback, to remedy which a cross between *Amaryllis* and *Valotta* has been by some recommended, and attempted without success, in order to obtain if possible evergreen varieties, or varieties which would produce foliage synchronously with their flowers. This genus must not be confounded with *Hippeastrum*, a much more tractable and variable genus of allied plants from Brazil. All cultivators interested in these and allied bulbous plants should see the remarks on the hybridisation of this genus in Dean Herbert's 'Amaryllidaceæ,' p. 278.

Crinum.—A large genus of remarkably stately bulbs, mostly natives of tropical Asia, South America, Australasia, and South Africa, and represented in our gardens by numerous species and varieties. One of the best-known plants in this group is *C. amabile*, which the late Dean Herbert believed to be a spontaneous hybrid between *C. procerum* and *C. zeylanicum*. *C. capense* and some of its forms are quite hardy, only needing a mulching during the winter to protect them from wet. In some gardens this is called *C. longifolia*. *C. Mitchamiæ* is (or was?) a very stately hybrid, also hardy, its parents being *C. capense* and *C. australe*. *C. Herbertii*, which bears blush-red striped flowers, is the offspring of *C. scabrum* and *C. capense*. This last-named species is figured as an illustration to the late Dean Herbert's celebrated "Observations on the production of Hybrid Plants."—(See 'Trans. Hort. Soc.,' iii. 187.)

The first hybrid Crinum appears to have been raised about 1813 in the greenhouse of the Earl of Carnarvon at Highclere. R. J. Gowen, Esq., was the raiser, and the plant was named *C. Goweni*, after him, when it first flowered in Dean Herbert's collection at Spofforth. It was the result of crossing *C. capense*

with pollen from *C. zeylanicum*. Soon afterwards several mules which had been raised at Mitcham by the Dean himself also bloomed at Spofforth, these having been obtained by crossing *C. capense* and *C. canaliculatum*. He also obtained one seedling from *C. defixum* fertilised with pollen of *C. speciosum*, and another from *C. scabrum* fertilised by *C. canaliculatum*, and a handsome white hybrid from *C. brevifolium* fertilised with pollen taken from a large form of *C. erubescens*. Dean Herbert, writing in 1842, remarks: "When I first introduced and described a number of species of Crinum which had not been known before in Europe, I was greatly censured by some experienced botanists for asserting that plants which they held to be species of *Amaryllis*, were in fact variations of the genus Crinum, and it was even declared that Crinum was more nearly allied to *Pancratium* than to the species in question. I proved the justice of my botanical view of that point by obtaining not merely sterile mules but a fertile offspring between the common Cape Crinum, which was before erroneously called *Amaryllis longifolia*, and the great *Crinum pedunculatum* of New Holland. I have now in my garden a further seedling from such a mule, between the *Crinum capense* and *Crinum canaliculatum*, which is closely akin to *pedunculatum*, with ripe seeds upon it. Generally these hybrids become impregnated by the pollen of *Crinum capense*, of which a great bed stands near them, and the offspring being two-thirds *capense*, revert nearly to its aspect; but the plant above mentioned did not revert, but exhibits an improved form of the mule, and is in fact a new fertile species. The freedom with which species of Crinum of the old Linnæan section and most of the section I added thereto interbreed, furnishes decisive proof that the faculty of intermixture is not confined to genera in which species have been rashly formed out of seminal varieties, but is found when the species were even erroneously considered to be of different genera." Nearly all the species of Crinum known to Dean Herbert were by him found to interbreed with tolerable freedom. One unintelligible impediment, however, existed, as he tells us ('Amaryllidaceæ,' p. 372), for some time *C. capense*, which bred freely with every other species, refused to be fertilised by the tropical Cape Coast kinds—*C. Broussonetianum*, *C. petiolatum*, and *C. spectabile*. A seedling was, however, at last obtained between the last named and *C. capense*. At the page above cited he remarks that, "in general, hybrid plants have been found to be excessively florid, but sometimes the contrary has been the case, and there appears to be some impediment to the perfection of their blossoms." At p. 351 he observes that a seed-pod from

Crinum capense which had been fertilised with pollen from *C. revolutum* was well developed, every ovule producing a seedling plant, a result not to be obtained by fertilising it with its own pollen; while at p. 356 he further observes that all the hybrid Crinums raised between *C. capense* and tropical species, which are now very numerous, are hardy enough to stand out of doors against the front wall of a stove, where, if a mat is thrown over them in sharp frosts, they preserve most of their leaves, and from May to November continue to throw up a succession of flower-stems in great perfection. *Crinum hybridum* (*C. erubescens* × *capense*)—(see 'Bot. Mag.,' t. 2336)—was raised from a seed ripened in a pond at Spofforth in 1818. In 1874 I saw a splendid plant in the late Mr S. Rucker's garden at Wandsworth in full bloom, and in the Dublin Botanic Garden also. *C. capense* forms a noble object in autumn.—(See Herbert's 'Amaryllidaceæ,' p. 272, for a list of hybrids and crosses, with their parentage, &c.)

Hippeastrum (Knight's Star Lilies).—A group of very showy, and for the most part deciduous, South American and West Indian bulbs, generally grown in gardens under the name of *Amaryllis*, from which, however, they differ in being deciduous, and also in being more readily forced, a general characteristic, indeed, of nearly all deciduous bulbs. The best-known species are *H. aulicum*, *H. equestre*, *H. regium*, which bear scarlet, crimson, or orange-red flowers with a greenish centre. *H. vittatum* (*H. Harrisonii*) is pure white striped with crimson. *H. pardinum* is creamy yellow, profusely speckled with vermilion; and *H. reticulatum*, an evergreen species, has rosy flowers finely netted with bright red. The hybrids in this genus are innumerable, as all the species, or nearly all, interbreed freely. One of the most brilliant and beautiful of all is the old *H. Ackermanni-pulcherrimum*. *H. regina-vittatum* is figured as an illustration to a valuable paper on Hybrid Hippeastrums in the Transactions of the Horticultural Society, v. 337. A numerous race of very showy hybrids has recently been raised by Messrs Veitch between *H. pardinum* and *H. Leopoldi*.

The first hybrid Hippeastrum, according to Herbert, was *H. Johnsoni*, named after its raiser, a nurseryman, who fertilised *H. vittatum* with pollen from *H. regium*. Numerous seedlings were afterwards raised between *H. Johnsoni* and such kinds as *H. psittacinum*—a green and scarlet flowered plant introduced from Brazil in 1816; *H. regium*, the Mexican Lily, introduced in 1725; *H. aulicum*, green and red, also Brazilian, introduced in 1810: while, more recently, numerous beautiful hybrids have

been obtained between the older varieties and *H. pardinum*—a beautiful creamy-yellow, fully-expanded flower, spotted or speckled with vermilion.—(See 'Bot. Mag.,' t. 5645.) Little skill is required in crossing Hippeastrums, since nearly all the hybrid and cross-bred forms are fertile, and a batch of seedlings is as diverse as Calceolarias in their colours, forms, and

Hybrid Hippeastrums

markings. The numerous forms of *H. bulbulosum*—an orange-flowered Brazilian plant introduced in 1810—are very bright and beautiful,—"fulgidum" (light orange), "ignescens" (fiery scarlet), and "refulgens" (orange scarlet) being perhaps the best. It is a singular fact that even what are supposed to be wild South American species vary very much from seed (even when not hybridised) in cultivation, and they have doubtless been intermixed in their native habitats. One of the oldest, most distinct, and hardiest of all the species is "Jacob's Lily" (*H. formosissimum*), introduced before 1629, and which, accord-

ing to Herbert, cannot be fertilised by pollen of the other kinds. This bears rich crimson flowers, and the flowers are quite different in shape to all the others. *H. reticulatum* is also a distinct variety, having flowers similar in shape and colour to those of *Amaryllis Belladonna*, with conspicuous net-like marking on the segments, the deep-green oblong evergreen foliage having an ivory-white stripe down the centre. Both the last-named seem to be pure species, which might possibly repay careful hybridisation under favourable circumstances.

Among recent cultivators who have raised improved forms of cross-bred Hippeastrums, I may name Messrs Veitch & Sons, who, I believe, have obtained the largest-flowered kinds in cultivation. In one batch of their seedlings I saw flowers nine or ten inches across, widely expanded, the segments being fully three inches in width. These were for the most part crosses between *H. Ackermanni-pulcherrimum* and *H. pardinum*. Messrs E. G. Henderson, of St John's Wood, have obtained a race of free-blooming and hardy varieties by crossing *H. pardinum* with some of the older hybrids. Mr J. Anderson, of Meadowbank, also raises numerous seedling forms, his strain being remarkable for brilliant colour. Mr B. S. Williams has also introduced some fine cross-bred forms, one or two of the varieties having very handsome creamy-white flowers, which contrast most beautifully with the scarlet and crimson varieties. For a very full account of this genus, the reader interested is referred to Herbert's 'Amaryllidaceæ,' p. 135; and at p. 142 is a list of many of the earlier hybrids and mixed crosses, with parentage and other interesting notes.

H. (*Amaryllis*) *vittatum* is figured in the 'Bot. Mag.,' t. 129, and is a distinct and beautiful white tubular-flowered form with crimson stripes. This is one of the most characteristic of all the earlier species. Some very beautiful hybrids have resulted from fertilising *A. psittacina* by pollen of the last-named plant; as also by the fertilisation of *A. vittata* with pollen of *A. pulverulenta* and *A. braziliensis*, and the last again by pollen of *A. acaulis*. Hybrids have been produced by *A. longifolia* fecundated by pollen of *A. formosissimum* (St Jacob's Lily); and *Crinum* (*Amaryllis*) *meldense* is from *A. longifolia* fertilised with pollen from *Crinum* (*Amaryllis*) *taitense*. We have one or two double-flowered Amaryllids in cultivation, so that their further multiplication is merely a question of time. *H.* (*Amaryllis*) *fulgidum fl.-pl.* (see 'Revue Hort.,' 1869, p. 411) is a glowing scarlet variety; and a full double variety was sent out by Messrs E. G. Henderson, a year or two ago, under the name of *H.* (*Amaryllis*) *Albertii*.

Imantophyllum (*Clivia*).—A group of free-blooming evergreen Amaryllids from the Cape, represented in our gardens by three or four species, including *I. miniatum*, *I. Aitoni*, *I. Gardeni*, and a very ornamental production, *I. cyrtanthiflorum*, which was raised by M. Van Houtte, of Ghent. It is a hybrid from *I. miniatum* fertilised with pollen from *I. Aitoni* (*Clivia nobilis*, Hort.) These plants are grown in some gardens under the name of *Clivia*, and are readily propagated either by division of strong clumps, or by seeds sown in a genial bottom-heat. Seedlings of *I. miniatum* are very variable, some of the forms being most profuse bloomers, and bearing large trusses of brilliant orange-yellow flowers.

Narcissus.*—We have here a distinct and natural group of hardy bulbs, principally natives of Europe, and numbering about twenty species, all of which are readily propagated by offsets, and many of them by seeds, which are very freely produced by the pure species under favourable conditions. Seeds should be sown as soon as ripe; for if kept until they become hard and dry, they germinate very slowly, and the young seedlings are weakly. For hybridising purposes pot the bulbs of the desired parents, and place them in the greenhouse or window, so as to isolate them from other kinds. Some of the late-blooming varieties, as *N. poeticus* and *N. Tazetta*, may be forced if pollen is required for crossing *N. Pseudo-Narcissus* and its varieties, which bloom early. "The six anthers should be carefully taken out before the flower which is to bear the seed-blooms opens. This may be done through a slit in the tube; and the yellow dust from another sort must be applied to the point of the style." After fertilisation is duly effected, and the seed-vessels begin to swell, plunge the pots in the open border in a sheltered position, carefully tie up the scapes, and watch the seed-pods when they commence to ripen, or the seeds will fall and be lost. Protect seed-pods carefully from mice and birds. When the pods show signs of bursting, cut the scapes, and keep them in water or moist earth until the seeds ripen, after which sow at once in pans or boxes of light sandy earth. Keep a sharp look-out for slugs, which will otherwise eat off every young plant as it appears.

There are numerous natural hybrids in this genus; and Dr Henon, who for many years made a special study of the French Narcissi, writes: "The station of Lattes, near Montpelier, is remarkable in that it offers many species mixed in the same meadow (*poeticus*, *angustifolius*, *biflorus*, *Tazetta*), as well as

* For a general account of the Narcissus, see 'Gard. Chron.' 1869, or 'The Narcissus; its History and Culture.'

a considerable quantity of intermediate forms, varieties, or hybrids. In 1840, along with MM. Dunal, Delile, and Bouchet, I asserted that at this station might be seen all the passages from *poeticus* to *Tazetta*, passing through *biflorus*, without any appreciable line of demarcation. This assertion was at the time strongly criticised; but verification being made on the spot with M. Delile, it was established that the fact was beyond doubt." *N. gracilis* is by some considered as a hybrid between a yellow *N. Tazetta* and *N. poeticus;* but its semi-cylindrical dark-green leaves point to *N. odorus* or *N. Jonquilla*, or even *N. juncifolius*, as one of the parents crossed with either *N. biflorus* or *N. poeticus*. *N. intermedius* has flowers of a yellow *N. Tazetta*, with leaves and scape like the Jonquil, and may possibly be a hybrid between the two groups. I find no evidence of *N. Bulbocodium* having been successfully hybridised with any other species; and its not having been used as a parent may be owing to its late-blooming habit.

In the August number of the 'Botanical Register' for 1843, No. 38, several curious hybrids are figured, which were raised by the late Honourable and Very Reverend Dean Herbert, "from seed, at Spofforth, and are amongst those which have already flowered." It is there stated by Mr Herbert that many Narcissi which have been distinguished as species, and even made into fresh genera, are never known to bear seed, and they are hence regarded as mules. Mr Herbert has entirely verified this supposition in some of his hybrids, producing what have been regarded as separate species or genera from two other decided species. Fig. 5 (see 'Bot. Reg.,' cited above), he says, is the produce of the wild Yorkshire Daffodil (*N. Pseudo-Narcissus*) fertilised by pollen of *N. poeticus*, and is decidedly a variety of the plant called *N. incomparabilis*. Fig. 3 is the produce of *N. incomparabilis* by the same *N. poeticus*—that is, two generations from the Daffodil by the poetic Narcissus—and in it the change is complete from the form of the stamina in the Daffodil to that in the true Narcissus; and it is evident that one cross more (or at least two further crosses) would out of the wild Daffodil produce the true Pheasant's-eye Narcissus. Other very curious instances are brought forward, and Mr Herbert says: "It is desirable to call the attention of the humblest cultivators—of every labourer, indeed, or operative who has a spot of garden or a ledge in his window—to the infinite variety of Narcissi that may be thus raised, and most easily in pots, at his window, if not too much exposed to sun and wind, offering him a source of harmless and interesting amusement, and perhaps a little profit and celebrity."

In the 'Gardeners' Chronicle' for June 10, 1865, the late Mr W. Backhouse, of St John's, Walsingham, makes the following pertinent remarks on hybrid Narcissi:—

"The Daffodils *Narcissus major*, *Pseudo-Narcissus minor*, and *moschatus*, cross with one another, and they produce seeds as freely as the parents. The colours are not merely intermediate, but of all shades between the colours of the parent where these differ, as in *moschatus*. *N. bicolor* seeds badly, and is deficient in pollen; but from crosses of the other Daffodils with it I have raised some of the largest and finest of the class. These also seed badly, and their produce has a tendency to revert to the Daffodil. The roots of *N. bicolor* are very large, and shaped somewhat differently from the others, and the crosses from it have the same peculiarity; the colours of the seedlings vary from those of their parents through white with lemon cups to almost pure white. From the Daffodils crossed by *N. angustifolius* (*N. poeticus*) the kinds called *fœtidus* by Dean Herbert are produced, and the cross is intermediate between the parents when *N. major* and *N. Pseudo-Narcissus* are used; but with *N. poeticus* the variety is greater, and some with very finely-expanded cups occur. The variety also seems to be greater when some of the seedling varieties of the Daffodil are used. These crosses seed very sparingly, but may occasionally be got to produce seed by a cross with either parent; those with the Daffodil having shorter cups than *N. major* and *moschatus*, and those with *N. poeticus* or *angustifolius* being intermediate, with generally a red edge to the cup. *Seeds I have sown from plants not artificially impregnated produce the same result*, some showing the Daffodil and others the *N. angustifolius* type. The orange tints on some of these crosses *vary in different seasons*. On many the cup will one year be orange-tinted, and the next plain yellow.

"The Daffodils crossed by *N. Tazetta* produce plants intermediate between the two in general, but sometimes the cup is not longer than in *N. Tazetta;* the flowers on each stalk vary —two, four, and up to six occurring. These crosses vary in colour and size according to the nature of the parent *Tazetta;* but the produce does not seed, except that last year one pod producing one seed occurred from, perhaps, a couple of hundred flowers. A warmer climate than mine might produce different results. No pollen is to be got from it to cross with the Daffodil parent.

"The percentage of seedlings showing striking peculiarities is but small from any of these crosses; and the colours only partially follow what might be expected from the parents. The

cross from *N. moschatus* by *N. angustifolius* is not always white, and I have from *N. fœtidus* (*N. incomparabilis*) by *N. angustifolius* some with green flowers."

The following interesting details are from the late Dean Herbert's valuable paper in 'Jour. Hort. Soc.,' ii. 1 *et seq.*: "I have seedlings from *N. Pseudo-Narcissus* by a yellow *Hermione brevistyla*, from *N. minor* by *papyracea*, *æquilimba*, and *italica* or States-general. All the breeders were forced near a month before the time of flowering, and were carefully deprived of their anthers some days before expansion by making an incision in the tube and drawing them out at bottom, so that they did not approach the stigma; and the non-access of the natural pollen was proved by the invariable failure of all the flowers touched with the pollen of certain plants, and the success of almost all touched with that of certain others. For instance, the failure was complete with pollen from Double Roman Hermione, which seemed very dry; of Soleil d'Or (doubtless because the bulbs have been raised by offsets for three or four centuries); of the large-anthered Queltias, except *montana;* of Bazelman major and minor, which, I am satisfied, are crosses between *Hermione brevistyla* and *Narcissus poeticus;* of *N. gracilis* and *tenuior;* of *Corbularia* and *Ganymedes:* while it is remarkable that almost every Ajax flower touched with pollen of Hermione States-general has seeded. The application of pollen of *Ajax luteus* or *moschatus* to *Narcissus poeticus* is almost sure of success. The constitution of the seedlings was very different. The seed of *N. Pseudo-Narcissus* crossed with *N. luteus* came up readily, and grew so fast and weak in the greenhouse in winter that it was necessary to put the pot out: that of the same Ajax which was impregnated by *Hermione brevistyla* came up very slowly, much of the seed rotting; and the seedlings did not find the house too warm, and were twice as many months as the others were weeks in reaching the same stature, and proved so delicate that, having been planted out in May, all but one of the first batch, which was much injured, rotted by the cold and wet in the autumn. One drawback is, that the seed of Narcissi is very apt to lie two years in the ground, unless sown immediately; and to rot, if it gets too much wet before it is ready to vegetate; and that the snails are apt to destroy the seedlings if raised in the open border; and that the hybrid seed, however good and fine, is more apt to suffer than the natural seed." Mr Herbert remarks that *N. odorus* never seeds in cultivation, nor yet in its native habitats, so far as he could learn; and this circumstance, together with the light of other experiments, caused him to surmise that it was a hybrid

between N. *Pseudo-Narcissus* and N. *Jonquilla.*" Some years later he writes that this opinion was verified, "[illegible] plants having been raised both by myself and by Mr [illegible], [illegible], near Caermarthen, and having flowered, they have shown that the Linnæan *N. odorus*—the genus *Philogyne*—in all its variations, is cross-bred between the common Daffodil and the Jonquil."

Some very beautiful seedling and hybrid Narcissi have been raised by Mr Edward Leeds of Manchester, many of which are very distinct. Among them are hybrids between *N. Pseudo-Narcissus* and *N. incomparabilis*, which possess the long corona of the first parent, and the more fully expanded and narrower segments of the latter. Hybrids between *N. incomparabilis* and *N. poeticus* are also pretty, the variations in form and tint being very numerous. Hybrids between *N. poeticus* and *N. Macleai* closely resemble the latter; and some seedlings from these again have turned out very fine forms, fully three times the size of the typical *N. Macleai*, and some have very bright vermilion-tinted cups. Hybrids between *N. incomparabilis* and *N. montanus* are intermediate in form, and very delicately coloured, having pale sulphur cups much frilled around the rim. Herbert gives the following particulars respecting the fertility and influence of the last-named species:—

"The pollen of *N. montanus*, whether it be a natural plant or not, is very fertile. I have flowered seedlings from *N. minor* by it, and very neat and pretty things they are. I have also flowered seedlings from *N. poeticus* by it, and they are remarkable,—having the widely-expanded limb of *N. poeticus* with the drooping posture and long cup of *N. montanus*, in one of them a little tinged with red. This is a strange circumstance. A plant widely different from any other species; cultivated above 200 years; not since found—as far as I can learn—where it was supposed to grow or elsewhere, except in gardens; producing no seed by its own pollen usually, if ever, yet very ready to fertilise its neighbours, and to be fertilised by a cross-bred plant. If it be cross-bred, I should say that *N. dubia* and *N. candidissimus* (*N. moschatus*) are its probable parents. From *N. Pseudo-Narcissus* and *N. minor* I have many crosses by *N. Tazetta*, especially the variety called States-general by the Dutch. *N. Pseudo-Narcissus* by States-general produces a very handsome vigorous two-flowered yellow *Diomedes* (Haworth), with some little variety of shape and tint.

"There is ample room for further experiments in this race of plants, from which much vernal beauty for our gardens and

rooms may be obtained, and even the curious little autumnal Narcissus and the autumnal green Jonquil may be brought into action. But the great value of these experiments lies in the strong light they throw on the wide variation which the Almighty has permitted from His created type with licence to revert towards the abandoned form, and by intermixture to produce new forms; while in other races, which exhibit less diversity of form amongst the species, the variation seems fixed."

Nerine.—We have here a very interesting genus of deciduous flowering bulbs, principally natives of the Cape, others coming from China and Japan. Among the species in our garden are *N. corusca* (scarlet), *N. flexuosa* (pink), *N. pulchella* (rosy lilac), *N. rosea* (rose), *N. sarniensis*, Guernsey Lily (scarlet), *N. undulata* (pink), and *N. venusta*, scarlet. The well-known and deservedly popular *N. Fothergillii* appears to be little more than a seminal form of *N. curvifolia major.*

They are readily propagated by division, offsets, or seeds sown in a gentle bottom-heat of 60° to 70° as soon as ripe, or early in the spring. Seedlings of *N. undulata* generally flower the third year from seed—others take longer; and seedlings of *N. curvifolia* are often eight or nine years before they flower.

Among the hybrids already raised may be mentioned those obtained at Spofforth prior to 1837 by the late Dean Herbert.* *N. Mitchamiæ* (= *N. versicolor*) is the result of crossing *N. curvifolia* and *N. undulata*. This has umbellate scapes of rose and purple flowers, the filaments of the stamens being bright red, while it is said never to produce fertile seeds.—(See 'Herb. Am.,' pl. 45, f. 1.) *N. Haylocki* is a hybrid between *N. curvifolia* and *N. pulchella*, the flowers similar in colour to the last, and it bears fertile seeds. Other hybrids obtained also by Herbert were: *N. claronis* (*N. pulchella* × *undulata*), *N. Parkerii* (*N. pulchella* × *humilis*), *N. Seymourii* (*N. humilis* × *undulata*), and *N. Spofforthiæ* (*N. venusta* × *undulata*).

The Guernsey Lily is one of the oldest and most beautiful, and might possibly be much improved by hybridising with *N. Fothergillii*; indeed *N. Plantii* is supposed to be a hybrid between the two last-named species.

The Periwinkle Family (*Apocynaceæ*).

A group of ornate plants represented in our gardens by the following genera: *Allamanda*, *Tabernæmontana*, *Vinca* (Periwinkle), *Nerium* (Oleander), *Rhynchospermum*, *Echites*, *Mande-*

* See Herbert's 'Amaryllidaceæ,' p. 283 *et seq.*

villea, and *Dipladenia*. Almost all the species are highly poisonous. These plants are nearly all very beautiful, bearing large brightly-coloured tubular flowers, having a broad five-lobed limb, and they are principally found in the tropics of both hemispheres, our native Periwinkles being the most northern representatives. These plants very rarely bear fruit in cultivation, notwithstanding Lindley's assertion (see 'Veg. King.,' p. 599) that the pollen is "immediately applied to the stigma." I believe it will be found that insect agency is requisite in a state of nature to secure fertility, and artificial fertilisation is necessary in order to secure seeds of this group in cultivation. The style is constructed in a peculiar manner, and, like the same organ in Lobeliads and Composites, seems intended to brush the pollen from the anthers for the benefit of other flowers. Nearly all the species are readily increased from cuttings of the young growth, or by sowing the seeds in a gentle bottom-heat of 70° to 75°, and the more delicate varieties of *Dipladenia* and *Allamanda* may be grafted on the more robust species of their respective kinds as a stock, inarching or splice-grafting being best. It would be interesting to know whether *Dipladenia*, *Echites*, and *Mandevillea* can be intergrafted or hybridised with each other in any way.

Allamanda.—A showy genus of tropical stove climbers or trailers, natives of South America, and represented in our gardens by six or eight species, all of great beauty. *A. cathartica* was the first species introduced to our gardens, this vigorous-habited species having been brought from Guiana in 1785 (see 'Bot. Mag.,' t. 388). *A. Schottii*, *A. grandiflora*, *A. Hendersonii* (*A. Wardleana*), and *A. nobilis* are the best; and are readily propagated by cuttings of the young wood inserted in moist soil, and plunged in a genial bottom-heat of 75° to 80°, either in a close frame or under a bell-glass, as the leaves soon droop if left exposed to the atmosphere. The four kinds just named are sometimes grafted on young plants (struck from cuttings) of *A. neriifolia*, *A. cathartica*, or its ally *A. Aubletii*, and are said to bloom more profusely when so treated. The operation is best performed in the spring under a close propagating case. I have never seen seeds produced; but this is doubtless owing to their requiring artificial fertilisation when in the cultivated state. They might doubtless be improved by judicious hybridisation. *Allamanda Hendersonii*: this is a distinct-habited plant of garden origin, and is supposed to be the result of a cross between *A. cathartica* and *A. Schottii* (see 'Proceedings Royal Hort. Soc.,' iv.) A double-flowered *Allamanda cathartica* was

obtained by Mr Hossack, of Alderley Park Gardens, Congleton, a year or two ago. The flower owes its "doubleness" to a substitution of petals for stamens, as is the case in the allied Oleander. We presume it is a "sport;" and if it is so, it certainly should have been perpetuated by cuttings or otherwise.

Dipladenia.—A showy genus of stove climbers from the Organ Mountains, Rio Janeiro, and Trinidad, bearing rosy salver-shaped flowers. They are readily increased by cuttings of the young side shoots, or breaks taken off in the spring with a heel of old wood and rooted in a gentle bottom-heat of 70° in a close case. The plants seed freely when artificially fertilised; and seedlings vary in form, colour, and substance. The seeds should be sown as soon as ripe in a gentle bottom-heat of 65° to 75°, care being taken to give ample ventilation whenever the young plants appear above the soil. *D. crassinoda* is a strong grower, and may be used as a stock for the tender varieties. *D. amabilis* is a hybrid raised by Mr Tuke, Bramley, near Leeds, in 1862, and sent out by Messrs Backhouse in 1865. It was the result of a cross between *D. crassinoda* and *D. splendens*, the latter being the male parent. *D. amœna* is another of Mr Tuke's hybrids, sent out about 1868, and is an improvement on *D. splendens*, obtained by crossing that species with *D. amabilis*. *Dipladenia Williamsii* is another garden hybrid, intermediate between *D. amabilis* and *D. splendens*—partaking of the free-blooming qualities of the former, and the great substance and boldness of flowers possessed by the latter—sent out by Mr B. S. Williams in 1874. About 1869 a plant of *D. amabilis*, in the gardens of J. Waterhouse, Esq., Wellhead, Halifax, accidentally produced a solitary fruit; and from the seeds it contained, his gardener, Mr Fenwick, succeeded in raising the garden variety known as *D. insignis*. In 1874 Mr W. Bull sent out another fine hybrid, or seedling, variety, under the name of *D. Brearleyana*. This is a rich crimson-scarlet variety, and was raised by Mr Brearley, a nurseryman, of Halifax, Yorkshire.

Nerium (Oleander).—A genus of poisonous plants of great beauty, represented in our gardens by the common Laurel Rose, *N. Oleander*, a native of the warmer parts of Asia, and largely grown as a decorative shrub in most Continental gardens. It is readily propagated by cuttings of the partly-hardened wood inserted in moist earth or in bottles of soft water (see Roses). Artificial fertilisation is necessary in order to obtain seeds, which germinate readily in a genial bottom-heat of 75° to 80°. For many years after this plant was intro-

duced, only the single and double rosy forms were known; but within the last ten or fifteen years it has been much improved by the French florists, who have given us white, buff, yellow, orange, salmon, rose, nankeen, and rosy-lilac varieties, which flower freely in a young and dwarf state, and these plants are now largely grown as decorative window-plants on the Continent. *N. Jeanne d'Arc* was one of the first of the pure-white varieties, and numerous other distinct seminal and cross-bred forms were raised by M. Mabire prior to 1862. According to the 'Revue Horticole,' M. Lambotte, an artist at La Muette, conceived the idea of grafting different varieties of Periwinkle on the Oleander, and successfully accomplished it. This is, however, not so surprising as it appears at first, for both genera belong to the Apocynaceæ. It is even probable that the pretty *Vinca rosea*, from Madagascar, would succeed on the Oleander—which, indeed, it somewhat resembles in habit, and in the shape and colour of its flowers. The success of experiments like this one, even if not of any practical value from a utilitarian point of view, teaches us much on the natural affinities of genera and species.

THE HOLLY FAMILY (*Aquifoliaceæ*).

Evergreen trees and shrubs found in various parts of the world, especially at the Cape of Good Hope, West Indies, and South America, but principally represented in our gardens by the common Holly, *Ilex aquifolium*, a plant pretty generally distributed throughout all the countries of Northern Europe. One South American species, *I. paraguayensis*, is of economic importance, its leaves being used as tea (see 'Jour. of Botany,' i. 30). *I. latifolia*, *I. rotundifolia*, *I. opaca*, and others, are well-known ornamental shrubs. The sports and seminal varieties of the common Holly are very numerous (See 'Gard. Chron.,' vols. 1874-75); and these differ greatly in habit, variegation, and in the colour of their fruit, there being both scarlet and yellow berried forms, as in the common Yew (*Taxus*). Hollies are readily multiplied by cuttings of the hardened growth inserted in autumn on a north border, or by layers; but the best and most successful plan of increasing the finer varieties, and any desirable break or sport, is to bud on the common Holly as a stock, either near the ground for bushes, or at a considerable height for standards. Hollies for stocks are best raised from seeds, which may be buried the first year and sown the second spring after they are gathered. I have

inserted buds of variegated Hollies at nearly all seasons—except the dead of the winter—with success; and in all cases the leaf at the base of the bud should be allowed to remain. Grafting may also be resorted to, but budding is preferable. M. Baltet recommends shield-budding in May or August, or oblique side-grafting from April to September, and remarks,—"Shield-budding is performed in the open air, with a pushing bud in May, with a dormant bud in August. Autumn grafts are best made under a *cloche* in the greenhouse, or under a cool frame. The leaf or leaves are left on the scion, and the air should be excluded from the grafted stock for about three months to insure the success of the graft. The operation succeeds perfectly well when the stock is potted at the time of grafting." I have often inserted buds of the variegated kinds on the branches of the green-leaved type, and these produce a pretty effect, the variegation appearing much more distinct when backed by the glossy dark-green foliage of the normal form of the species.

THE AROID FAMILY (*Aradaceæ*).

The most general and unsystematic observer must have noted that, in addition to the small groups of vegetables which are more or less locally distributed over the earth's surface, there are larger families having a more universal distribution—such as Ferns, Orchids, Grasses or Corn-plants, Aroids, Palms, and Conifers. A few general remarks on each of these great groups will be given alphabetically under their respective heads. The true Aroids—as *Caladium*, *Alocasia*, *Dieffenbachia*, and *Philodendron*—have unisexual flowers borne at the base of a fleshy club-shaped spadix, and protected by a more or less convolute spathe, which in many cases is hooded. *Anthurium*, on the other hand, has bisexual or hermaphrodite flowers, and is by some botanists referred to Orontiaceæ on this account; but for all practical purposes they may be spoken of here. Our figure (*a*, *b*) shows the arrangement of the floral and sexual organs in this group; while the following general remarks on their fertilisation are from a very interesting article by M. Karl Koch, in the 'Gardeners' Chronicle,' 1875, p. 398, 399, on some hybrid Philodendrons and Anthuriums obtained a few years ago by M. Kellermann of Vienna. The hybrids obtained by M. Kellermann were *Philodendron Simsii* × *pinnatifidum*, *P. pinnatifidum* × *Selloum*, *P. Wendlandii* × *Selloum*, and *Anthurium leuconeurum* × *pedatoradiatum*—all of which are fully described in the paper above cited.

"Respecting the fertilisation of Aroids, it should be observed that, as in many of the cereals, self-fertilisation does not take place, but the flowers of one spadix are impregnated by pollen from the flowers of another plant, or by pollen from the flowers of a different spadix of the same plant. The stigma of Aroids is susceptible while the pollen is still securely enclosed in the

Arum maculatum, showing the spathe (a) and the spadix (b)

anther, and before it has reached perfect development. The length of time during which the stigma is capable of receiving the pollen varies according to the season, but, as a rule, only for the short period of at most four or five hours. Usually this occurs during the night, when the spathe begins to open, or more frequently when the heat of the spadix is most perceptible. It rarely continues sensitive for a longer period, as in the genus *Caladium*. The pollen never retains its power of impregnation for a very long period—as a rule, only two or three days. Like

most tropical plants in our hothouses, Aroids are seldom fertilised without aid; and if good seed be desired, it is necessary to resort to artificial impregnation.

"The susceptibility of the stigma appears to be of the longest duration in Caladiums (perhaps in all species of *Caladium*), hence the chances of fertilisation are proportionately greater. More significant is the fact that they never appear to intercross with one another; at least M. Kellermann never succeeded in effecting a cross between different species of Caladiums. Moreover, whilst Caladiums in general vary very little, or not at all, in the shape and colour of their leaves, one species exists which, even in the wild state, as first demonstrated by Wallis with the specimens he sent to Paris, gives birth to numerous varieties. We may therefore assume that in this case there is no necessity for fertilisation with the pollen from a variety with differently-coloured leaves, and that the pollen of the same variety, though of a different individual, is sufficient to give birth to a series of new varieties of the most diverse colours. Great praise is due to the Parisian druggist, M. Bleu, for what he has done in the way of raising new varieties of this class. Kellermann's hybrids have a decided horticultural value in addition to their botanical interest, for they belong to the most ornamental of plants with fine foliage, and they will thrive well in a dwelling-house. And then equally beautiful variegated forms of *Caladium* have been raised in Belgium, Germany, &c. Among others, Skopitz, of Petschka, in Bohemia, raised and sent out a long series of fine-foliaged varieties, which were in no respect inferior to those raised by M. Bleu. Unfortunately they are very little known abroad, though one of the chief ornaments of most Austrian gardens.

"Three varieties of *Caladium* with coloured foliage were known long before Miquel described the green-leaved type under the name of *C. surinamense*—namely, *C. pœcile*, *pellucidum*, and *picturatum*. The next variety of remarkable beauty was raised at Schönbrunn, and published under the name of *C. hæmatostigma*. Like *C. surinamense* and *C. pellucidum*, it was raised from seed, but in all cases the plants were fertilised with their own pollen. Therefore M. Kellermann is right in saying that Caladiums naturally possess a tendency to vary in the markings of their leaves. No better proof of this is required than that furnished by the green-leaved *C. surinamense*, whose seeds produce variegated varieties." As to Caladiums, it seems evident that many of the kinds formerly grown in our gardens as species were merely cultivated varieties.

The first coloured or variegated Caladium cultivated in this

country appears to have been *C. bicolor* (see 'Bot. Mag.,' t. 820). It was introduced by Messrs Lee and Kennedy in 1773 from Madeira, being there cultivated as an ornamental plant.

As is stated above, variegated seedling forms of Caladium have been raised in French and Austrian gardens; and in this country M. Bause, when chief propagator at Chiswick in 1868-69, raised a race of very beautiful but tender, golden-leaved varieties, some having veins of the brightest carmine imaginable. M. Bause also succeeded in raising a hybrid *Dieffenbachia*, since named *D. Bausei*, the result of a cross effected between *D. picta* and *D. Weirii*.

One of the most interesting points observed in connection with the fertilisation of Aroids is the generation of heat during the time the stigmas are in a fit state for fecundation or the application of pollen, and it is absolutely necessary that this time be selected for fertilising purposes. Mr Anderson-Henry, in his paper on "Hybridisation," notes the fact that crosses between remotely-allied species of plants may be most successfully effected during those peculiar conditions of the atmosphere when the air is charged with electricity, ozone, and latent heat. This statement is doubly interesting when we couple it with the fact that in most Aroids heat is actually generated by the spadix when the stigma is in the receptive state; and it is well known that tree-growth is made most rapidly during the warm, still, humid nights of May, when electricity is abundant in the atmosphere, as shown by weak flashes of lightning in quick succession, unaccompanied by thunder.

Several hybrid Alocasias have been raised by Mr John Seden in the Chelsea Nursery, among which the following have been distributed: *A intermedia* is a hybrid obtained between *A. longifolia* and *A. Veitchii*. *A. Chelsoni* is an intermediate between *A. macrorhiza* and *A. metallica*; *A. Sedeni* between *A. Lowii* and *A. metallica*; while *A. Veitchii*, var. *superba*, is a hybrid between *A. Lowii* and *A. Veitchii*.

THE ARALIA AND IVY FAMILY (*Araliaceæ*).

Trees, shrubs, or herbaceous plants, nearly related to Umbellifers, but generally having fleshy fruits and evergreen glossy leaves. *Panax*, *Adoxa*, *Aralia*, *Dimorphanthus*, *Sciadophyllum*, *Gunnera*, and *Hedera* (Ivy), are the principal genera. Nearly all the species are natives of tropical or subtropical regions, but they are also represented in Europe, North America, and Japan. Several species cultivated in

China and Japan have stimulative qualities: the leaf-stalks of the Rhubarb-like *Gunnera scabra* are farinaceous and edible; while the delicate rice-paper used by Chinese artists is prepared from the pith of *Aralia papyrifera.* Our native Ivy is, next to the Holly, one of the best examples of the variation in colour, size, form, and habit which may be induced or facilitated by cultivation. *Gunnera* may be increased by careful division from root-cuttings, or from seed when obtainable. Many Aralias are best increased by root-cuttings sown in moist compost on a genial bottom-heat: or grafting cuttings on pieces of root by cleft or splice grafting is successful; and as the roots of some of the common species may be employed, this mode is often more to be recommended than cuttings of the root. The operation should be performed neatly, the root stock and scion firmly tied, air and wet being excluded by mastic or wax; after which pot the cuttings so treated in light rich sandy compost, and plunge the pots in a close case or under a hand-light on a genial bottom-heat (or tan bed) of say 70° to 80°. In the 'Illustration Horticole' is described an excellent method of propagation—and this is to select only the lateral, or, as it were, adventitious shoots which are formed on the main stem. These should be taken off young and at once placed in heat, just as we should treat ordinary soft-wooded cuttings. This simple system has been successfully employed by M. Cornélis, head-gardener to Viscount Vigier, at Nice, in the propagation of *Oreopanax dactylifolia* and other difficult species. In order to facilitate the production of lateral shoots, or the development of latent buds, it is often necessary either to cut off the terminal growing point, or to remove it in a rooted state by ringing or girdling, and surrounding the cut part with soil or moss. The choicest variegated forms of Ivy may also be grafted on cuttings or seedlings of the common *Hedera helix*, or on those of the Irish Ivy as stock, cuttings and layers being also successful. Cuttings are best inserted on the shady side of a wall or fence in October or November, where they may be allowed to remain until the following autumn.

The Hoya and Stephanotis Family (*Asclepiadaceæ*).

The plants of this highly interesting order are readily known by their monopetalous flowers, superior ovary, and waxy pollen-masses similar to those of many Orchids. In our gardens they are represented by many species of *Asclepias*, *A. curas-*

savica and *A. tuberosa* being common examples. Another distinct group is the succulent-stemmed leafless "Carrion-flowers," or *Stapeliads*, the twining *Stephanotis*, the honey-distilling *Hoyas*, the shrubby *Centrostemma*, and the curious hooded or dome-flowered *Ceropegias*. Their fertilisation* depends to a great extent on insect agency, and Professor Riley has recommended horticulturists who are much troubled with bees to plant *Asclepias cornuta* (Silk-weed), of the nectar from which bees are passionately fond; and in their visits to the flowers of this plant they become so laden with the viscid pollen-masses that they fall down and die in great numbers. From the 'Treasury of Botany,' p. 99, we learn that "the manner in which the ovules of these plants (*Asclepiads*) are fertilised by the pollen is among the most curious phenomena known in plants. Instead of the grains of pollen falling on a viscid stigmatic surface, and then producing tubes of impregnation, the tubes are formed inside the pollen-bags, whence they ultimately find their way by a spontaneous emission, and reach the surface of the stigma without being projected upon it, conducted by some inherent vital power."—(See 'Lind. Med. Bot.,' 4th ed.) The tubular flowers of *Stephanotis*, like those of some Dogbanes, and those of *Aristolochia clematitis*, are set with rigid deflexed hairs inside the tube, the use of these being to entrap any flies which enter, and keep them prisoners until fertilisation has been effected, after which they lose their stiffness, and allow the insect to escape. *Arauja* (*Physianthus*) *albens* also entraps the humming-bird hawk-moth by a singular movement of the waxy pollen-masses. Asclepiads can be distinguished from Apocynads (Dogbanes) only by their Orchid-like or waxy pollen. The following are the principal cultivated genera: *Asclepias*, *Stephanotis*, *Centrostemma*, *Hoya*, *Ceropegia*, *Brachystelma*, *Apteranthes*, and *Stapelia*.

Hoya (Honey or Wax Flowers).—A genus of scandent tropical Asclepiads, principally natives of Java, China, and New Holland, and represented in our gardens by *H. carnosa*, *H. bella*, *H. Paxtoni*, *H. imperialis*, and several others. There is a creamy variegated form of *H. carnosa*. All the species may be readily propagated either by stem or leaf cuttings, in heat, and covered with a bell-glass. *H. carnosa* and *H. Paxtoni* bear fruit rarely, a circumstance owing in all probability to their flowers being accidentally fertilised by insect agency. Seeds grow freely sown in light sandy earth in a

* See 'Trans. Linn. Soc.,' xvi. 685 and 715, for account of their sexual organs and methods of fertilisation.

genial bottom-heat of 60° to 70°. No hybrids have been raised in gardens, but this might readily be done. Their pollen is in waxy masses, like that of most tropical Orchids, and will be found embedded in radiating slits or cavities of the fleshy column or disc in the centre of the flower. Fertilisation may be easily effected by smearing these glutinous masses on the viscid stigmatic surface, which can be seen through a lens. The drop of nectar or honey secreted on the stigma of *Hoya* is one of the best of all mediums in which to grow pollen-grains—*i.e.*, cause them to emit their fecundating tubes on a slide for microscopic examination; and this being so, it might be found of great service by hybridisers to quicken the pollen placed on the stigmata of other flowers. In many cases the natural secretion of limpid moisture on the stigma does not seem suited to the requirements of the foreign pollen applied in hybridising; and when this is observed to be the case, it is advisable to remove a drop of the secretion from the stigma or stigmas of the pollen-bearing parent, and place it on the stigmas to which the foreign pollen is to be applied. The mucus of *Hoya* seems congenial to the growth of nearly all pollen-grains; but a series of experiments made with the nectar and pollen of different flowers is much wanted, and might throw much light on the subject of hybridisation and cross-breeding.

Stapelia (Carrion-flowers).—This is a singular genus of succulent Cape plants, which numbers nearly a hundred species; but a very small proportion are now to be found in ordinary gardens. They are branched, leafless plants, which seldom grow under cultivation more than a foot high, and which bear curious stellate, waxy flowers, that vary greatly both as to size and colour. A marked and well-known peculiarity connected with the flowers of these plants is their unpleasant, and in some cases even repulsive, odour. Another marked feature in their economy is their having waxy pollen-masses analogous to those of many Orchidaceous plants. The carrion-scent emitted by the flowers, by attracting flies, is doubtless subservient to the process of artificial fertilisation, without which the seeds of these plants could not be produced. It is very common, when these plants are in bloom, to see great blue flies busily engaged in depositing their eggs right down the centre of the flower; and in doing so, they not unfrequently dislodge the pollen-masses, and thus unconsciously effect fertilisation. It is useless to attempt striking cuttings during the dull autumn or winter months, as the shoots do not then possess vital energy enough to emit roots, but damp off. Some

of the species, as *S. asterias*, *S. Plantii*, *S. hirsuta*, *S. hystrix*, and *S. grandiflora*, are very effective when in flower, and seldom fail to attract attention. Seed is freely produced by healthy plants, but artificial fecundation is necessary in order to induce the plants to fruit. The seeds are closely packed in slender spindle-shaped capsules five or six inches in length, and grow readily if sown as soon as ripe in a pan of light sandy soil, placed on a gentle bottom-heat until they vegetate; after which elevate them near the glass, and water carefully, as they are very apt to damp off. I am not aware that hybrids have been raised in this genus, but it seems probable that this might easily be done; and the results would be very interesting. The best collections in this country are at Kew; and Mr Peacock's collections at Sudbury House, Hammersmith, and at the Alexandra Palace. It does not appear to be generally known that the Brachystelmas may be grafted on Stapelias, as stocks, or the weak and tender Stapelias may be worked on the more permanent and vigorous kinds. The operation is best performed in June or July, when the plants are in full growth and vigour. It should be noted that the stems of *Stapelia* seldom live longer than three or four years if allowed to bloom; but employing them as stocks, which prevents their forming bloom-buds, increases their permanence.

THE ORANGE AND CITRON FAMILY (*Aurantiaceæ*).

A small group of fruit-bearing or ornamental trees, principally natives of the East Indies, and represented in our gardens by the Orange, Lemon, Citron, and Shaddock. Although nearly all the plants in the order are tropical, the Orange and Lemon have long been cultivated in South Europe, as well as at St Michael's and the East Indian Islands. *Limonia laureola* is said by Lindley to be the only plant in this group which is naturally found on the tops of cold and lofty mountains, where for several months it is covered with snow. It is found on the high hills in North India; and a nearly-allied plant, *L. trifoliata*, is employed in China and Japan as a stock for tender and choice varieties of the sweet Orange, and more especially for *Citrus japonica* or "Kumquat," which this stock renders extremely fruitful. Like all other cultivated fruits, all the Orange family are extremely variable in earliness, size, colour, and flavour—this being partly owing to their being propagated from seed, and partly owing to the sudden development of sports or bud variation. Good varieties are readily propa-

gated by grafting either on the Limonia stock or on seedlings of the common kinds. Seedling Lemons are found to be more vigorous, to grow faster, and to make better stocks than Oranges. Seeds taken from imported fruit grow freely if sown in moist earth and placed in a warm greenhouse or vinery; and these may be splice, whip, or side grafted in a close case in heat at almost any time: preference, however, should be given to the early months of the year, when vegetation is most active. Young branches of Orange or Lemon trees in flower or fruit

Flowering branch (a), fruit (b c), of an Orange; d, Flower complete; e, Pistil, f, Transverse section of ovary

may be readily grafted in a close case, as recommended for Gardenias. A gentle bottom-heat of 80° to 90° is necessary; and the stocks should be placed in heat a week before grafting takes place, so as to facilitate the success of the operation. Side-grafting under the bark answers well, or splice-grafting if both stock and scion are young and slender. Cuttings of the young wood root freely in heat, and soon form blooming plants if potted in loam and sand and placed in a light airy plant-house. Nearly all the so-called species succeed as scion and stock, and cross-fertilisation has doubtless played an important part in producing the numberless varieties and races which exist in this family.

THE BALSAM FAMILY (*Balsaminaceæ*).

A small group of thick-jointed, herbaceous plants, nearly succulent in their character, and principally annuals, which seed freely in our gardens, and hence are easy of propagation. One of the finest of all the species introduced to our gardens is *Impatiens coccinea* (see 'Bot. Mag.,' t. 1256), which is a most profuse bloomer, bearing its bright rosy flowers in the axils of the ovate-serrate leaves. The varieties of the garden Balsam originated from *I. balsamina* (*Balsamina hortensis*), one of the prettiest of half-hardy summer-blooming annuals. This plant may be readily increased by cuttings, which root freely in sawdust. Two or three white, rosy, and yellow flowered species are useful as winter-blooming stove-plants, and these might be much improved by judicious hybridising. *I. flaccida*, *I. Hookeri*, and *I. latifolia* (see 'Bot. Mag.,' t. 5625) are very useful and attractive decorative plants, but upwards of a hundred species of perennial Balsams, some of which are very beautiful, exist as weeds in Ceylon, the Western Ghauts, and on the Himalayas, the colours of their flowers varying from pure white, as spotless as that of a Phalænopsis or St Bruno's Lily, through all the shades of peach, flesh, and rose to a deep rosy-purple bordering on crimson; others are yellow Seeing what has been effected with *I balsamina*, there seems here a wide and varied field of improvement.

THE BEGONIA FAMILY (*Begoniaceæ*).

This order is represented by many species of *Begonia*, an ornate genus of flowering and foliage stove or greenhouse plants, principally natives of South America and tropical Asia. *B. insignis*, *B. fuchsioides*, *B. Dregei*, *B. nitida*, *B. Rex*, *B. Veitchii*, *B. Boliviensis*, and the numerous half-hardy hybrids (which have originated from the two last-named species and the golden-flowered *B. Pearcei*), are well-known examples. These plants are monœcious, and bear seed freely if cross-fertilised.

In the 'Journal of the Linnæan Society,' 1871, xi. 472, is an interesting illustrated account of a species of Begonia from Brazil, in which "all the male flowers show a tendency to become hermaphrodite—one, two, or three of the central stamens being transformed more or less completely into pistils." Occasionally this tendency may also be observed among the tuberous-rooted varieties now so largely cultivated in our

gardens. Darwin, in his 'Animals and Plants under Domestication,' also mentions that *B. frigida* produces some hermaphrodite flowers with an inferior perianth.

There is still a large unworked field in this genus. Seeds grow freely sown on a pan of sandy leaf-mould and peat, covered with a bell-glass or flat pane, and placed in a gentle bottom-heat of 65° to 75°. Cuttings of the erect-growing kinds —as *B. insignis*, *B. fuchsioides*, and others of similar habit—root freely in a close case or beneath a bell-glass; and all the fleshy-leaved species and varieties are readily propagated in quantity by making cuttings of the old leaves by nicking the fleshy ribs or veins beneath, and then pegging down the leaf on a pan of sandy compost. Some cut the leaf into pieces and insert each section as a cutting. Some species of Begonia, especially *B. bulbifera*, *B. diversifolia*, *B. discolor*, *B. monoptera*, *B. Martiana*, *B. parviflora*, and some others, develop axillary buds; and while these buds, which are analogous to those of *Lilium bulbiferum*, may be taken off and preserved throughout the winter in paper bags or sent to a distance, they also develop into plants much more rapidly than seeds, and simply require the same treatment.

Colonel Trevor Clarke, F.R.H.S., has very kindly given me the following notes as to the parentage, &c., of the many hybrid Begonias he has raised during the last thirty years :—

1. *B. acuminata* × *B. fuchsioides.*—A useful autumn and winter flowering plant, with remarkably handsome habit of growth, now apparently gone out of cultivation.

2. *B. cinnabarina* × *B. Clarkii.*—A splendid plant, now lost.

3. *B. cinnabarina* × *B. Veitchii.*—A large showy plant.

4. *B. cinnabarina* × *B. Pearcei.*—Clear orange flowers; leaf of Pearcei. This is a very effective plant, well worth general culture.

5. *B. Dregei* × *B. cinnabarina.*—A very pretty little plant; was tried out of doors successfully twenty years ago.

6. *B. dipetala* × *B. cinnabarina.*—Habit of dipetala, with red flowers; too much overpowered by the foliage.

7. *B. Dregei* × *B. insignis.*—Useful for winter; of no great beauty.

8. *B. Dregei* × *B. Pearcei.*—*Vide* No. 17. These two were very much alike, but inferior to No. 18.

9. *B. Dregei* × *B. heracleafolia.*—Curious, but of no beauty. (See No. 13.)

10. *B. Dregei* × *B. Sutherlandii.*—The well-known *B. Weltoniensis.* This is one of the most beautiful of all Begonias.

11. *B. discolor* × *B. cinnabarina.*—A superb plant, but most difficult to grow.

12. *B. Dregei* × *B. smaragdina.*—A rather singular-looking thing, very handsome in foliage.

13. *B. heracleafolia* × *B. Dregei.*—The converse of No. 9; differed in being larger in all parts and more prostrate.

14. *B. heracleafolia* × *B. cinnabarina.*—Illustrative of a bad cross.

Takes from the female parent; stems adscendent at the base, but tall and unwieldy from the influence of the male parent. The colour of the mother plant being dull, the resulting red blossoms were of a dull and unattractive character.

15 *B. insignis* × *B. nitida*.—A very elegant plant, flowering for months in succession.

16 *B. insignis* × *B. cinnabarina*.—A handsome plant worth reproducing. One seedling was a full double as to the male blossoms. Raised in 1841.

17 *B. insignis* × *B. Pearcei*.

18. *B. insignis* × *B. nitida* × *B. Pearcei*.—Of these crosses, which were much alike in general habit, the last was the best. It is a very beautiful plant.

19 *B. insignis* × *B. manicata*.—A large, singular, but rather ungainly plant.

20 *B. insignis* × *B. platanifolia*.—Better than the last, but awkward in habit.

21 *B. insignis* × *B. fuchsioides*.—Nothing remarkable.

22 *B. Martiana* × *B. cinnabarina*.—Habit of B. Martiana, bright red flowers: was delicate, and soon lost.

23 *B. Martiana* × *B. Boliviensis*.—A tall, rather striking plant, with pale rosy flesh coloured flowers.

24 *B. nitida* × *B. cinnabarina*.—Very like No. 16, but with somewhat more robust habit.

25 *B. prismatica* × *B. species*.—A large edition of *B. prismatica*. The peculiar shape of the capsule was lost in the cross.

26 *B. Pearcei* × *B. cinnabarina*.—Differed scarcely from No. 4.

27 *B. Platanifolia* × *B. manicata*.—A handsome plant, flowering with the leaves, whereas in the mother plant the flowers are produced before them. The "manica" or frill on the leaf stem is obliterated by the cross. This is a case of the gain of one quality at the expense of another.

28 *B. Richardsii* × *B. Sutherlandii*.—A pretty plant, but inferior to *B. Weltoniensis*.

29 *B. semperflorens* × *B. fuchsioides*.—Useful winter plant, with bright flowers, too sparingly produced.

30 *B. fuchsioides* × *B. cinnabarina*.—Only one plant raised, was very pretty, but delicate, and soon lost.

31. *B. manicata* × *B. crassicaulis*.—An improved manicata. The fringed "manica" is lost in this cross, but the plant flowers *with* the leaves, which in the case of *B. crassicaulis* are produced after the flowers.

In the 'Gardeners' Journal,' 1847, p. 615, two hybrids are figured and described by the raiser, Mr. P. N. Don, then of the United Nursery, King's Road, Chelsea. Speaking of Begonias, he says: "They are worthy of attention on account of their easy hybridisation; and many beautiful varieties may be obtained by paying a little attention to the species that are to be crossed. The two following varieties (*B. prolifera* and *B. hybrida*) were raised from seed of *B. manicata*, crossed with *B. coccinea*. A fact worthy of notice is, that from one seed-pod the species *manicata* and the two varieties here represented were all raised in great numbers—a proof that the pollen did not effect a change in the whole of the seeds, which is not easily accounted for, as the

whole of the flowers (male) were taken off *B. manicata* before the time of crossing, and continually removed as they appeared, until the pod began to swell, and no others were in the house at the time. The two varieties I have named *Begonia hybrida* and *Begonia prolifera*."

B. hybrida has creeping stems; oblique, pale, glossy leaves; reddish brown underneath, with reddish hairs, and a tendency to bear frills, like the female parent. It bears large corymbs of pale flesh-coloured flowers, nearly all female and fertile.

B. prolifera is of more erect habit, with narrower leaves, more deeply toothed than the last. The stem and leaves are covered with young plants mixed with glandular hairs. Flowers large rose, in pendent corymbs from the axils.

B. hybrida multiflora is a free-flowering hybrid, the result of crossing *B. fuchsioides* with a pink-flowered plant of the *B. insignis* group.

B. Digswelliensis is a beautiful hybrid raised by Mr W. Earley between *B. odorata*, as the female or seed-bearing parent, and *B. fuchsioides*, as the male or pollen parent. Mr Earley also informs me that *B. phyllomaniaca* (not of the 'Bot. Mag.')—(for which he received a first-class certificate at the International Horticultural Exhibition in 1866) was obtained from *B. odorata* fertilised with pollen of *B. recinifolia*.

B. valida is a hybrid raised by M. J. B. A. Deleuil from seeds of *B. longipila*, fertilised with pollen from *B. Boliviensis*. The large oblique cordate leaves are of a deep lucid green colour; the flowers rose, borne in an ample panicle. Several interesting hybrid Begonias have also been obtained by M. Stange. Some of these hybrids were gained by fertilising *B. Rex* with pollen from *B. lazuli*, while *B. splendida* produced fertile seeds when fecundated with the pollen of *B. xanthina*, *B. annulata*, or *B. laciniata*. Another Continental hybridist, M. Malet, obtained a numerous batch of seedlings—all sterile —by fertilising *B. discolor*, a hardy plant, with pollen of *B. Rex*, *B. Dregei*, *B. xanthina-Reichenheimii*, and *B. nivosa*. *B. xanthina-marmorea*, fertilised by its proper pollen, produced seven or eight distinct forms, *B. pulcherrima* being one of the best. *B. rubro-venia*, fertilised with pollen of *B. xanthina*, produced *B. Gandavensis*, *B. marmorata*, *B. lætevirens*, and several other hybrids. M. Regel has noted that when a fertile hybrid is obtained between two species of Begonia or other plants, it is capable of producing numerous and variable forms, even if fertilised with its own pollen or with that of one of its parents. By using pollen from one of its parents, however, we often favour the reversion of the offspring to that parent; and this

is especially the case if we take pollen from the one that is strongest or most vigorous. A better plan is to cross the hybrid with pollen from a different species entirely, as this is found to add a fixity of character to the offspring. This fact is easily explained, since, when we unite the combined characteristics (evident and latent) of two species, it follows that that parent species in which the characteristics are most firmly fixed gives way the least in the process of hybridising, and the characteristics of the progeny incline most to that parent. Hence this inclination to revert to one of the parents may be overcome either by fertilising the hybrid progeny with pollen from what was in the first case the female or weakest parent, or by crossing with pollen from another species, which in nearly all cases is found to fix the wavering or reversional characters of the second generation from seed.

Numerous hybrids of the *B. Rex* section were obtained by cross-fertilising that plant with *B. xanthina*, *B. lazuli*, *B. splendida*, *B. Griffithii*, and others, and these were very popular in our gardens about 1856-60, but have been driven out of culture by the more brilliant and useful tuberous-rooted class.

B. Model belongs to the "tuberous-rooted" group, and is a hybrid of the third generation, the result of in-and-in crossing carried on between *B. Boliviensis* and *B. Pearcei* in the first instance, and then with *B. Veitchii*, and afterwards with *B. Sedeni*. The result of this interbreeding was the production of *B. Stella* and *B. Model*, both certificated varieties, out of the same batch of seedlings. For a coloured figure of *B. Model*, see 'Florist,' 1875, p. 109, 110. Numerous highly-coloured forms, including *B. Vesuvius* and others, have since been obtained by Messrs Veitch & Sons in this section.

B. Boliviensis was introduced by Messrs Veitch & Sons from Bolivia, and has erect stems 2-3 feet high, and axillary, long-petalled, cinnabar-scarlet flowers (see 'Bot. Mag.,' t. 5657). *B. Veitchii* is a hardy species in sheltered positions, having been introduced (also by Messrs Veitch) from near Cuzco, on the Peruvian Andes. It is dwarfer and more compact in habit, bearing peduncles of orange-scarlet, broad-petalled, wax-like flowers (see 'Bot. Mag.,' t. 5663, and 'Florist,' 1868, No. I. p. 1). *B. Pearcei* has rich velvety, deep-green leaves, mottled with lighter green, and bears axillary panicles of pure yellow flowers of good size and substance (see 'Bot. Mag.,' t. 5545). The three plants above named are interesting as being the parents of the comparatively new section of Begonias known as "Tuberous-rooted." *B. Sedeni* (see 'Florist,' 1869, p. 169) was one of the first hybrids obtained, its parents being *B.*

Boliviensis and an unnamed species. Although a hybrid, it seeds freely, its progeny being very variable in colour; indeed, I have seen red, magenta, carmine, rose-yellow, lilac, vermilion, and pure white forms produced from the same seed-pod.

HYBRID AND CROSS-BRED TUBEROUS-ROOTED BEGONIAS.

Hybrids.	Parents.		
B. Sedeni,	B. species	×	B. Boliviensis.
B. intermedia,	B. Veitchii	×	B. Boliviensis.
B. Chelsoni,	B. Sedeni	×	B. Boliviensis.
B. Stella,	B. Sedeni	×	B. Veitchii.
B. Vesuvius,	B. Sedeni	×	B. Clarki.
B. Excelsior,	B. cinnabarina	×	B. Chelsoni.
B. Model,	B. Pearcei	×	B. Sedeni.
B. Acme,	B. intermedia	×	B. Sedeni.
B. Emperor,	B. Clarki	×	B. Chelsoni.
B. Dominii,	B. Rex	×	B. argentea.
B. Chambersii,	B. Pearcei	×	B. Sedeni.

B. octopetala, recently reintroduced into our gardens by M. Frœbel & Co. of Zurich, is the largest-flowered species in the genus, and may possibly be induced to hybridise with other species (see 'Flor. des Serres,' 1874, p. 25).

The above species, and earlier hybrids, have been made the parents of innumerable very beautiful and richly-coloured forms, both in our own gardens and also in those on the Continent. Hybrids between the glowing scarlet-flowered and compact-habited *B. Frœbeli* (a new Andean tuberous-rooted species sent by M. Roezl to MM. Frœbel of Zurich, about 1874) and the large-flowered *B. octopetala* have been obtained by M. Frœbel, so that we may expect a new race rivalling those hybrids now in cultivation.

M. Schmidt, of Lyons, has obtained a race of free-flowering varieties, the result of cross-breeding between *B. insignis*, a well-known perpetual bloomer, and some of the tuberous-rooted kinds. The colours of these hybrids vary from white salmon and pink to a rich carmine. Messrs Veitch & Son also obtained several seedlings between their new tuberous-rooted varieties and *B. insignis*, but they were discarded as not being superior to other kinds. *B. hybrida*, "Montblanc," is a hybrid between *B. Pearcei* and *B. discolor* (see 'Revue Hort.,' 1876, p. 67).

B. Spinksii (*Chiswick*).—This is a hybrid between *B. Pearcei* and *B. Boliviensis*; the leaves are like the former, and the flowers of the same shape as the latter, but of a yellow colour tinged with rose.

B. ascotiensis is rarely seen in English gardens, although com-

monly grown as a decorative plant by the Parisian florists. It is a seedling raised at Ascot by the late Mr J. Standish.'

The following little account of its introduction to French gardens from the 'Revue Horticole' may interest hybridists: "This Begonia, so common and turned to such good account with us, is scarcely known in England, although it originally came from there, M. Keteleer having a few years ago bought it of Mr Standish, of Ascot, for half-a-crown. Messrs Thibaut and Keteleer sold such plants as they raised of it at an equally reasonable rate; and it was not until last year, when M. Duval was awarded a prize for some fine specimens of it, that its value became apparent. Plants of it, which at one time could be bought for a shilling or little more, now realise as much as twelve francs or half-a-sovereign."

A race of hybrid fine-foliaged Begonias was raised a few years ago by M. Boulard from *B. subpeltata* fertilised with pollen from the well-known *B. Rex*. M. Boulard also originated a variety named *B. smaragdina venulosa*, this being the result of a cross between *B. smaragdina* and *B dædalea*. These were distributed by MM. Thibaut and Keteleer, of Sceaux, in 1870.

A hybrid Begonia named *B Marshalli* was raised and exhibited by Mr Marshall at South Kensington a year or two ago; and it is a little singular to note that Mr Dominy also had a hybrid at the same time exactly like it, the last being the result of a cross between *B. Rex* and *B. argentea*, and in some gardens this plant is grown as *B. Dominiana*.

A double-flowered form of *B. Sedeni* made its appearance in one of the public gardens of Lyons in 1873, and has been successfully perpetuated. M Victor Lemoine, of Nancy, originated a double-flowered form a few years ago. The male flowers *only* were double, each being the size of a florin, and of a bright scarlet colour. This has been described in the 'Revue Horticole,' part iv., 1874, as *B. monstrosa plena*, and in the 'Garden,' vii. 323, as *B. Lemoinei fl.-pl.* The same raiser has since originated a fine race of double-flowered forms, and these will be a great gain from a decorative point of view, as the single varieties are rather fugitive. We have several times seen hermaphrodite flowers of *B. Chelsoni* formed by the fusion of a male and female flower; and W. E. Gumbleton, Esq., has described a similar form of fasciation between two flowers of *B. Emeraude* (Van Houtte), in which a male and female flower having come into contact were fused into one immense bloom, with both stamens and pistils distinctly visible in the centre, and the incipient seed-vessel fully developed at the back of one of the halves of the flower.

In the Wellington Nurseries, St John's Wood, where many hundreds of hybrid Begonias are grown, we noticed a pretty double-flowered one, of a pale blush or pink colour, and of good substance and form. We are informed that the plant in question bloomed for the first time in 1872, and that it has since then well sustained its character.

A beautiful double-flowered Begonia of the *Boliviensis-Veitchii* group was exhibited at the Paris Horticultural Exhibition of 1875 by M. Lemoine, of Nancy. The plant was healthy and vigorous, and the flowers large, double, and of a bright orange-red colour.

The Berberis and Mahonia Family (*Berberidaceæ*).

A small natural group of dwarf herbaceous perennials (*Epimedium*), or deciduous or evergreen shrubs (*Berberis*). The flowers are mostly yellow, borne in axillary clusters, and are remarkable as having sensitive or contractile stamens, which close around the style if irritated with a pin. The anthers discharge their pollen from two oblong apertures, each of which is closed by a little trap-door-like contrivance or valve, which seems designed to secure the pollen from the effects of damp. Nearly all the species fruit freely; and some —as *B. vulgaris*, *B. aquifolium*, and *B. asiaticus*—are then highly ornamental. *B. Darwinii* is one of the best of the early-flowering species. It is interesting to notice that the stamens of *Berberis* are individually sensitive, just as are the leaves of the Sensitive plant and *Dionæa*.

Berberis.—Nearly all the species are readily to be multiplied by seeds sown as soon as ripe either in open air or nursery-beds, or in boxes of light rich sandy earth in a pit or frame. Tender varieties are best sown in boxes. Cuttings are successful inserted on a north border in the autumn, while the low-growing kinds are readily propagated by layers. The seedless form of *B. vulgaris*, which is much esteemed for preserving, must be propagated either by cuttings or by grafting, as suckers fail as a rule to reproduce the seedless form. It would be interesting to know the cause of the berries of some individuals being seedless, while others growing in the same soil, and apparently of the same age, produce fertile seeds only. Some Grapes, Cucumbers, Melons, and Passion-flowers furnish us with analogous cases; and it seems probable that the cause is insufficient fertilisation, owing to debilitated pollen—a state of things not unfrequently brought about in cultivated plants

by continually propagating from cuttings or layers, while the nutrition of plants also affects their sexual fertility in a marked manner. *B. (Bealii) japonica* is one of the noblest of all the species in sheltered southern counties, or as a cool conservatory shrub; and this might be improved by seminal variation and selection, or possibly by hybridising. We have many seminal forms of *Berberis* in our gardens, and one or two hybrids.

At a meeting of the Royal Horticultural Society, October 2, 187[illegible], Messrs Standish & Co. exhibited an interesting batch of seedlings from *Berberis stenophylla*—itself a reputed hybrid; and these were of the most diverse character, no two being alike.

The Hybrid Mahonia (*B. fascicularis hybrida*) is a handsome shrub, 5-8 feet in height, bearing pinnate deep-green leaves, 5-7 leaflets, and producing a profusion of golden flowers in the spring. It is perfectly hardy, and very superior to any of the forms of *M. aquifolia*, and is said to be a hybrid production raised between *M. repens* and *fascicularis*, in the nursery of Mr Rivers of Sawbridgeworth, in Hertfordshire. Its synonyms are *Mahonia repens-fascicularis* and *M. aquifolia fascicularis*.

Epimedium.—A genus of pretty little plants of easy culture, bearing very attractive white, rose, or violet coloured flowers. They are distinguishable from *Berberis* by their flowers consisting of parts of four, there being four sepals, eight petals, and four stamens, the bilobed anthers of which are valvular, as in the last-named genus. *E. alpinum* is the only European species, the most showy kinds being natives of temperate Asia and Japan. Numerous very beautiful hybrids have been raised in Belgian gardens; and among the best of these, *E. atroroseum*, *E. rubrum*, *E. versicolor*, *E. lilacinum*, *E. sulphureum*, and others, were raised by that veteran hybridist M. Donkelaar. A pale-yellow-flowered hybrid has been raised by fertilising *E. colchicum* with pollen from *E. macranthum*.

THE BIRCH AND ALDER FAMILY (*Betulaceæ*).

A small group of slender-growing trees or shrubs, represented in our woods and forests and gardens by different species and forms of *Betula* or Birch, and *Alnus* or Alder. Although generally natives of Europe, N. Asia, the Himalayas, and N. America, they are also found in Peru and Columbia; while in the Alpine regions they are the last trees found on the barren limits of eternal snow. Birch-wine is pre-

pared from the sap of the Birch, obtained by tapping the trunks in the spring. Both Birch and Alders are easily-propagated by seeds sown in the autumn as soon as ripe, or in the spring in shallow trenches in the open ground. Large branches or truncheons of the Alder root freely when driven into the earth to the depth of a foot or more, like Willows; and propagated in this way, it grows vigorously, and is valuable for strengthening the banks of rapid-flowing rivers or streams. The ornamental golden-leaved Alders, and the purple, weeping, cut-leaved, and other cultivated forms of Birch, are readily reproduced by grafting on their respective types as a stock.

In a recent number of the 'Illustration Horticole,' M. André mentions having seen at a horticultural exhibition at Orleans a specimen of a Purple Birch. It originated as a chance seedling, was grafted on to the common Birch and was thus exhibited. It has a weeping habit, and deep violet-purple leaves.

The Trumpet-Flower Family (*Bignoniaceæ*).

A very beautiful group of trees or shrubs, often of twining or scandent habit, and represented in our gardens by *Bignonia*, *Tecoma*, *Catalpa*, *Jacaranda*, *Amphicoma*, *Eccremocarpus*, and one or two other showy genera. Nearly all the species are easily multiplied by cuttings, layers, or seeds, careful artificial fertilisation being often necessary to obtain the latter. *Eccremocarpus*, however, seeds very freely, and the young plants often flower the first year. At Burghley, near the gardener's cottage, *E. scaber* has naturalised itself on an old stone wall, where it does not grow so luxuriantly as in warm soils; but it is far more floriferous than I have seen it elsewhere, and it produces a large supply of fertile seeds. The scandent species of *Bignonia* and *Tecoma* may be multiplied by simple or multiple layering; and it would be interesting to know to what extent the species of different genera can be grafted on each other, as affording some indications of their natural affinity. We already know that *Bignonia radicans* may be grafted on *Catalpa syringæfolia* as a stock. A correspondent of the 'Horticulteur Français' headed back some of the branches of a *Catalpa*, and inserted scions of the *Bignonia* by cleft-grafting, the result being that from the midst of the cool green *Catalpa* foliage emerged numerous flowering branches of the *Bignonia*. It would be interesting to experiment with other species of *Bignonia* and *Eccremocarpus* on the *Catalpa* stock, and also worked on each other.

All the *Bignonias* and *Tecomas* are readily increased by grafting, or by cuttings of their own roots. *Bignonia grandiflora* (see 'Bot. Mag.,' t. 1398) is a noble plant, bearing large trusses of glowing orange-scarlet flowers. This species, *B. venusta*, and several other kinds which require a warm greenhouse temperature, may be propagated by grafting on roots of *B. radicans* or *B. capreolata*. This operation should be performed in a close heated case. *Bignonias* and *Tecomas* are so handsome that it is a wonder they have escaped the magical touch of the hybridiser, to whom we must look for varieties of dwarfer habit and more floriferous character. Grafting may possibly be found to improve some of the rampant-growing species if a weak or moderate-habited kind be selected as a stock; and the success of this operation will also indicate the affinity necessary to insure good results from hybridising. *B. grandiflora*, var. *rubra*, is a seedling raised by M. Sahut of Montpelier, its presumed parents being *B. grandiflora* and *B. atropurpurea*. It is one of the finest of all the *Bignonias*, and *B. atropurpurea* was the seed-parent.

THE WALLFLOWER AND CABBAGE FAMILY (*Brassicaceæ*).

This is a large and very natural group of plants, represented in our gardens by innumerable forms of the common wild Cabbage (*Brassica oleracea*), Radish (*Raphanus sativus*), Turnip (*Brassica napa*), to say nothing of showy herbaceous plants and alpines. There are few natural orders which produce fertile seeds so universally as these, and nearly all the species may be most readily increased from seeds sown either in the autumn as soon as they are ripe, or in the spring. Cuttings of most of the species root freely if covered with a hand-light or *cloche*, or inserted in pots and placed in a close frame. The following are among the best-known genera: *Matthiola* (Stocks), *Cheiranthus* (Wallflowers), *Nasturtium* (Water-cress), *Arabis*, *Cardamine*, *Lunaria* (Honesty), *Alyssum*, *Aubrietia*, *Draba*, *Cochlearia*, *Thlaspi*, *Iberis*, *Anastatica* (Rose of Jericho), *Sisymbrium*, *Capsella*, *Ionopsidium*, *Lepidium*, *Æthionema*, *Brassica*, *Crambe* (Seakale), *Raphanus*, and *Schizopetalon*. All the cultural forms of *Brassica*—such as the Cabbage, Colewort, Savoy, Brussels Sprout, Cauliflower or Broccoli, and Kales of all kinds—are extremely susceptible of cross-fertilisation; and it is next to impossible to secure a pure strain of any variety unless it is isolated from all the other individuals of its species. To keep

a good strain from degenerating, change of soil and extreme care in selecting typical or perfect seed-bearing plants are absolutely essential. Although the Cabbage is a native of England, it appears the cultivated or succulent-leaved hearting form was first brought to our gardens from Flanders; and the Brussels Sprout, as indicated by its name, originated in the neighbourhood of Brussels, whence, until very recently, our main supply of the best seed was obtained.

Brassica (Cabbage).—This is the most important of all the species in this group, and is a native of Britain, as also of other parts of Europe. The wild maritime plant is very different from some of its numerous forms and races; but Professor Buckman found that seed obtained from the true wild *Brassica oleracea* from the rocky coast of Llandudno, N. Wales, gave very diverse progeny, with both red and green foliage when cultivated; and the same author also found that when Rape and common white Turnips were grown together and allowed to seed, a proportion of the produce has been malformed Swedish Turnips, which became much improved in quality by careful cultivation. Nearly all the forms are treated as annuals for food purposes, and as biennials when seed is required. Seed is abundantly produced, but isolation is necessary to prevent deterioration by interbreeding. It is a singular fact that nearly all the forms of Cabbage and Kales are of better flavour after having experienced a sharp frost or two.

For a valuable memoir on the races, varieties, and sub-varieties of the Wild Cabbage (*Brassica oleracea*), see 'Trans. Hort. Soc.,' 1821-24, v. 1, by M. A. P. de Candolle, who describes the following six races as its descendants: 1st race, *Brassica oleracea sylvestris*, or Wild Cabbage; 2d race, *B. oleracea acephala*, Tall or Open-headed Cabbage; 3d race, *B. oleracea bullata*, Savoy or Blistered Cabbage; 4th race, *B. oleracea capitata*, Round-headed Cabbage; 5th race, *B. oleracea caulo-rapa*, Chou-rave or Turnip Cabbage; 6th race, *B. oleracea botrytis*, Broccoli, Cauliflower, or Flowering Cabbage. The second species or type is *B. campestris*, or Field Cabbage, of which he describes the following races: 1st race, *B. campestris oleifera*, Colza; 2d race, *B. campestris palmaria*, intermediate between the last and the 3d race, *B. campestris napo Brassica*, or Chon-navet. Third species or type, *B. rapa*, or Turnip: 1st race, *B. rapa depressa*, Common Round Turnip; 2d race, *B. rapa oblonga*, Long Turnip; 3d race, *B. rapa oleifera*, Wild or Oil-giving Turnip. Fourth species or type, *B. napus*: 1st race, *B. napus oleifera*, or

Rape; 2d race, *B. napus* [illegible], French Turnip. Fifth species or type, *B. praecox* [illegible], early French Field Cabbage. Sixth species or type, *Raphanus sativus*: 1st race, *R. sativus radicula rotunda*, Round or Turnip Radish; 2d race, *R. sativus radicula oblonga*, Long Radish; 3d race, *R. sativus radicula oleifera*, Slender Chinese Radish.

The professor adds the following observations on the hybrid or cross-bred varieties of the preceding species: "There is no doubt that many of the plants which I have enumerated are cross-breds, accidentally produced and preserved by the care of the cultivator. The cultivated Cabbage, according to M. Sageret, presents a singular phenomenon—that of being incapable of receiving fecundation from any but its own species; he tried in vain the pollen of Colza, as well as that from every other species of Brassica: he then found out that it had a natural tendency to fecundate several other species of Cabbage, and even the cultivated Black Radish; but it could not, as before observed, be impregnated by any except its own varieties. The *Brassica oleracea botrytis* has not, however, undergone a trial with it. It appears that the cross-breds known in gardens are produced without any interference. The Colza, the Chou-navet, and the Ruta-baga appear from these experiments to be hybrid products of the Cabbage and Turnip taken in different degrees of culture and domestication; they are none of them capable of crossing the true Cabbage, but may all become fruitful by its means. They can produce among themselves other cross-races which bring their own seeds to perfection. The Colza, in particular, cannot be considered as the type of the cultivated Cabbage, as MM. Duchesne and Lamarck supposed; but its manner of mixing in artificial breeds shows, as I have already observed, that it forms a type by itself. One might suppose that the Colza was originally produced from the Cabbage and the Navette; *Brassica campestris pabularia* by the Cabbage and the Oblong Turnip; the *Napo Brassica* by the Cabbage and the White Turnip; and the Ruta-baga by the Cabbage and the Yellow Turnip." M. Quetier made some interesting experiments in hybridising *Raphanus caudatus* with the common Garden Radish, and also with a variety of Cabbage (*Chou de Vaugirara*).—See 'Revue Horticole,' 1868, p. 376.

Cheiranthus (Wallflower).—A favourite genus of hardy and fragrant flowers, represented in almost every cottage-garden by some form of *C. cheiri*, a native plant, common on old ruins in various parts of the country. In Shakespeare's time the

hybrid or cross-bred nature of these plants and Stocks seems to have been known, since in the 'Winter's Tale' we find the injunction—

> "Then make your garden rich in gilliflowers
> And do not call them bastards."

Parkinson (1629) figures and describes many varieties of Wallflower, including the old double yellow and the large double red, neither of which appear to have undergone any material change in size and doubleness of flower during two centuries of cultivation. Besides these old varieties, however, the German florists have originated a very beautiful race of new forms; and these double German Wallflowers are highly recommended for their beauty and fragrance. Their culture is simple—merely to sow the seed in April in a light warm soil, or a gentle hotbed in the open air; to transplant them to rich soil early in June; and in October to pot, three in a pot, into 10-in. or 11-in. pots, and place them in an orchard-house. In March they put forth their glorious spikes of flowers, often from 2 ft. to 3 ft. in length. These fine flowers have been obtained by the German florists; and the variation in colour is very remarkable, some being dark brown, others purple, others grey, and others shades of yellow from straw to gold.' Choice Wallflowers, and more particularly the fine double-flowered kinds, are readily propagated from cuttings of the lateral shoots during the summer months. Take these off carefully with a heel, and insert them at once in a cool shady border, covered with a thin layer of well-washed sand; and after sprinkling them, place a hand-light or *cloche* over them until they commence growing, which they do as soon as roots are formed. Propagation from cuttings may at first sight appear tedious, but it will not be found so in practice. Besides, there are some advantages to be derived from it which are not so strictly within our reach when propagating from seed,—viz., the certainty of commanding groups of this lovely flower, all double; and the equal certainty of perpetuating any favourite or peculiar variety.

Several other species deserve culture, such as *C. alpinus*, a dwarf form of Wallflower, *C. ochroleucus*, and *C. linifolius*. *C. Marshalli* is a very effective hybrid plant, although often referred to, even in botanical books, as a species. Its parents were the perennial *C. alpinus*, or *C. ochroleucus*, and the brilliant orange-flowered annual *Erysimum Peroffskianum*. Mr A. Dean thus alludes to this hybrid in the 'Gardeners' Chronicle:' "Mr Allen, of Shepton Mallet, having recently

obtained from *C. Marshalli* seedlings that closely resemble the *Erysimum Perofskianum*, it is doubly interesting to find that this hardy annual was one of its progenitors. An examination of *C. Marshalli* shows that it differs from *C. ochroleucus* both in colour and form of foliage, and in the form of the flower-stalk, which latter, as it elongates, much resembles that of the Erysimum. And in the foliage and habit of growth it will be found that what divergence from *C. ochroleucus* there is, is evidently towards the foliage and habit of the Erysimum also. I have often tried to get seed from *C. Marshalli*, but without success, and have on several occasions used pollen from the flowers of the dwarf yellow Wallflower, but to no purpose. I am told that structurally the seed-organs of the flowers are perfect, but why no seed is produced is a mystery. It would seem, however, that the flowers are not devoid of pollen, as I have found natural crosses produced on the yellow Wallflower—one plant exhibited by me at South Kensington last spring showing the effects of the cross in a marked degree. It is worthy of remark that whilst the rich orange hue of the flowers of Marshalli renders it the most attractive kind, yet it is not so robust or by any means so freely propagated as is its old perennial parent"

Mathiola—A well-known group of sweet-scented plants of dwarf habit, commonly grown in gardens under the name of Gilliflowers or Stocks There are several strains or races, such as the Brompton, Queen's, Intermediate, Wallflower-leaved, East Lothian, Pyramidal, and others These races have partly descended from *M annua*, and some of these strains have been improved by crossing or hybridising with *M incana*, a perennial species *M. maderensi-incana* is a hybrid, as indicated by its trivial name, and its pollen being always fertile it seeds freely.

Stocks are, as a rule, propagated by seeds, but in order to perpetuate double Stocks, says the 'Florist,' it is recommended, when the varieties are in full bloom, to take off as cuttings the lateral shoots beneath the flowers (before they show bloom), and to prepare and plant them like those of other soft-wooded plants, placing them in a cold frame, and shading them until roots have pushed out freely In this way it is said that plants more symmetrical in shape, and blooming more profusely than those generally raised from seed, are produced. At Erfurt, whence comes the main supply of German Stock seeds, about 600,000 flower-pots are annually planted with about 3,600,000 of these plants, for the purpose of obtaining seeds. These pots, placed in a single row, would

reach nearly 50 miles! In the year 1863, 150,000 pots were planted with 1,550,000 Gilliflowers for seed, and these brought in an income of nearly 50,000 thalers. The production of the Gilliflower, in 16 varieties and over 200 colours, established the horticultural fame of Erfurt. The Erfurt seed-growers grow their seed-bearing Stocks in pots placed on shelves in dry airy houses; and only just sufficient water is given to prevent the plants from flagging. So treated, the seeds are less numerous, but plumper and better ripened; and about 70 per cent of double flowers is the average obtained. Some growers also thin out the capsules, or remove the tops of the inflorescence when six or eight capsules are formed. A correspondent of the 'Garden' (vol. viii., 1875, p. 123) says: "Three years ago I had Mauve Beauty, and accidentally allowed the seed to stand ungathered through the winter; and in the spring finding a few capsules left, I gathered them, sowing the seed in March as usual. I have since adopted this plan, and my difficulty has been to get single flowers for seed, fully nine-tenths being double."

A correspondent of the 'Gardeners' Chronicle,' 1853, p. 406, obtained a cross between the Red Giant Stock and the Purple Queen, the first being the seed-parent. The seedlings came purple like the pollen-parent, and are described by Dr Lindley as being "extremely handsome, perfectly double, and a most beautiful purple." The raiser remarks that "the affinity between purple and scarlet in some flowers is curious, they being apparently forms of the same colouring matter—witness the Zinnia. Geraniums, crossed by *fulgidum*, produce both purple and scarlet broods."

THE PINE-APPLE FAMILY (*Bromeliaceæ*).

A very distinct natural order of plants, containing many ornamental species, the only plant of economic interest being the Pine-apple (*Ananas sativus*), a native of the West Indies, and now much cultivated at St Michael's, Azores, whence the fruit is largely imported to this country. Nearly all the species agree in their vasiform habit of growth, some having striped, blotched, or irregularly barred or netted leaves, while others bear gorgeous panicles of scarlet, blue, purple, or crimson flowers. One of the species, *Tillandsia usneoides*, or Long Moss, hangs from the trees in swampy N. American forests; and, like many of the S. American species, it is epiphytal. *T. argentea* is one of the smallest and rarest of all

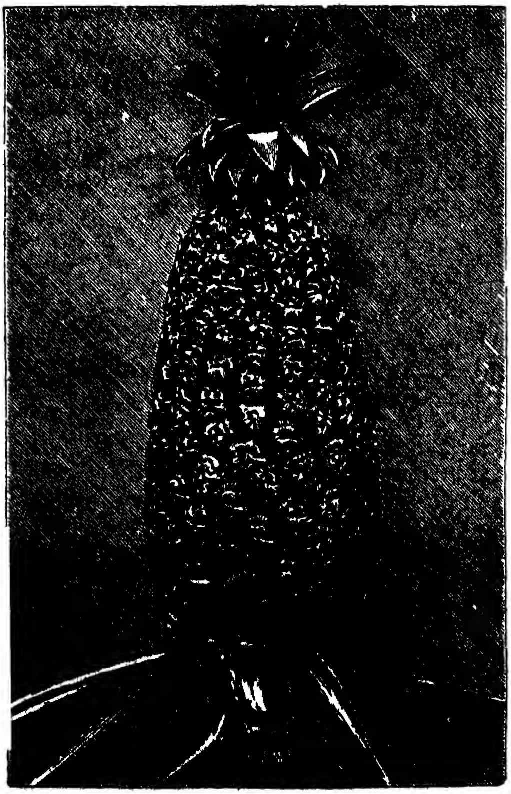
the decorative species. Their diversity of character and persistent foliage, added to the brilliance of their flowers, ought to make these plants much more popular than they now are in our gardens. Many of the species seed freely, and are readily propagated by sowing on pans of fine, sandy earth, after which place the pans in a close case on a genial bottom-heat of about 75°. The species of *Bilbergia* rarely perfect seeds in our hothouses unless carefully fertilised; and this is true of many other Bromeliads. *B. zebrina* has ripened seeds in Continental gardens, as also has *B. vittata* in the Luxembourg garden. One fruit, we are told (see 'Belg. Hort.,' 1875, p. 120), was obtained by fertilising flowers of *B. vittata* with pollen from other flowers on the same plant, which had been kept in a paper in the pocket for three days; and two other fruits on the same plant were produced by fertilising the stigmas with pollen from *B. pallescens*, this pollen having also been preserved in the same manner. It is interesting to observe that flowers impregnated with pollen in a fresh state did not produce fruit—indeed, the preservation of the pollen in this case had a beneficial influence; and hybridisers should bear this little fact in mind, especially when operating on Bromeliads. Nearly all the plants in this group have a tendency to throw up offsets after flowering; and these may be taken off and struck in heat as cuttings, or they may be allowed to remain on the parent stock until they naturally throw out roots, after which they can be removed and potted in the usual way. I may here allude to an ingenious method practised in order to induce plants to produce their suckers. A short poker or iron bar is heated red-hot, and plunged down the centre of the plant, but only just far enough to stop the central growth; and as a natural consequence, the vital force of the plant is then diverted to the production of lateral shoots and suckers, which are taken off and propagated in the ordinary way. The Pine-apple was originally discovered and described by Jean de Lery in his voyage to Brazil in 1555, and was first brought to this country by Lord Garland in 1690, and soon after it was cultivated by Rose, gardener to Charles II. Like most other cultivated plants it is highly variable, the variation being in many cases merely cultural, while some of the forms now grown in our gardens are seminal varieties; and doubtless this fruit might still be much improved by crossing distinct forms, and carefully selecting the resulting offspring. As a rule, however, Pines, if left to themselves—*i.e.*, if not cross-fertilised—rarely produce fertile seeds, this sterility having been favoured in our gardens during the past two centuries, owing to the

almost invariable method of propagating from offsets or suckers. We scarcely want fertile seeds in the case of our fruit-bearing plants, the chief object in cultivating these being to favour the development of the fleshy or pulpy covering, as in the Pine, Pear, and stone-fruits, where we strive to obtain small stones and a large proportion of edible pulp. Miller, while noting that seeds of the Pine are but rarely produced in Europe, remarks that if seeds were procured and sown, the varieties of Pine-apples would soon be as numerous as Apples and Pears. Miller himself sowed seeds and found them to produce varieties of different degrees of vigour and excellence. Mr J. Fleming, of Cliveden, writing to the 'Florist,' 1868, p. 134, makes the following interesting observations on this subject: "The great drawback to the usefulness of the variegated Pine-apple as a decorative plant is the presence of the saw-like spines on the leaves, which render it dangerous indoors. In order to try and remedy this, I made an attempt in the spring of 1865 to cross the smooth-leaved Cayenne with the pollen of the variegated variety, but whether any cross took place is doubtful; I think not, though every flower operated upon set a seed. The fruit proved a very fine one. To make all certain, I took it to Berry Hill, where Mr Rogers assisted in searching out the seeds. It was some time before we could make certain of them, not having seen any before. In this instance they were kidney-shaped, a little larger than a millet-seed, brown in colour; and, through a glass, were seen to be irregularly veined all over, making the dark surface appear like specks of rich velvet. The seeds, if not too ripe when the fruit is cut, are enclosed in small ear-like cells, covered by closing up the bract, which is no doubt provided by nature to protect the seed from birds, &c., as this bract does not commonly grow downwards until the flowering is over.

"We found in all over fifty seeds, every one of which vegetated freely; but although the plants all differed in some way, not one of them showed any light variegation. I left a few seeds with Mr Rogers, who is a very successful Pine-grower. He was the first to ripen a fruit—in about eighteen months. It weighed four pounds, and was pronounced by Dr. Hogg to be very handsome in shape, but deficient in flavour. The latter may improve; it would not, I think, be possible to improve on the habit. There are about one in five smooth-leaved. Several have fruited since, but none so remarkable either in shape or habit."

In the 'Transactions of the Horticultural Society,' 1835 (2d ser.), i. 1, is a valuable account of 52 varieties then

growing in the Chiswick Garden, from which we learn that large numbers of seedling Pines were raised at Blithfield, the seat of Lord Bagot; others by Mr Thos. A. Knight (Knight's Downton Havannah being one of the best). The well-known Montserrat is believed to have been raised from seed at Slingborough. Buck's Seedling Globe Pine was raised



at Elford, in Staffordshire, in 1819. The Enville, a kind still grown, was raised from seed at the Earl of Stamford and Warrington's seat of that name, but at what date is uncertain. Large quantities of Pines were raised from imported seeds in the gardens at Welbeck by Speechly.

Of late years numbers of seedling Pine-apples have been

raised at Lambton Castle (see 'Gardener,' 1876, p. 80). Out of the first batch of 30 seedlings the best was that here figured, and which has been named the Lambton Castle Pine-apple. Mr Hunter fertilises artificially, and recommends that the fruit should be allowed to partially decay, in order to give time for the plumping up of the seeds.

THE CACTUS FAMILY (*Cactaceæ*).

This order consists of succulent spinose shrubs, for the most part natives of South America, where some of the columnar species of Cereus, as *C. peruvianus* and *C. giganteus*, attain a height of from 20 to 30 feet. The number of known genera is said to be eighteen, and about 600 species are known. Two species only are of economic interest,—viz., *Opuntia coch-inellifera* (Nopal plant), largely cultivated in the Mexican States as the food-plant of the cochineal insect (*Coccus cacti*), well known as affording a beautiful crimson dye; and *O. vulgaris*, or Prickly Pear, which is cultivated for its grateful sub-acid, gooseberry-like fruits in barren rocky parts of North Africa and Southern Europe. We have no work in English devoted to these interesting plants as yet; but M. Labouret's 'Monographie des Cactées' is handy for reference, and contains a full account of most of the species. Cacti are easily propagated as a rule; and the following general directions are by Mr J. Croucher, who is well known as one of the most intelligent cultivators of these and other allied plants:—

"*Propagation.*—The genera Rhipsalis, Phyllocactus, Cereus, and Opuntia are easily increased by cuttings, which should be taken off in May, and laid in the sun till rooted, when they should be potted and watered carefully, though Rhipsalis and Phyllocactus may be potted at once, and kept dry about fourteen days, when they will be rooted, and may be watered; Echinocactus and Mammillaria must be increased by offsets." All the finer kinds of Mammillarias—as *M. crucigera*, *M. scopa*, *M. scopa candida*, *M. scopa cristata*, *M. declivis*, and others—may be grafted on *Cereus Napoleonis*, *C. tortuosus*, or *C. serpentinus*, as stocks. When grafted, they are cleaner and better than when on their own roots. *Echinocereus pectiniferus*, *E. pectiniferus cristatus*, and others, may be worked on *C. peruvianus*; and the larger Echinocacti do well on the strong-growing columnar forms of Cereus, two or three stems being used where one is not sufficient. "Echinocacti require their tops to be cut off, which must be exposed to the sun

until rooted; the old plant will throw out young ones, which may be taken off the next season. As a rule, the Echinocacti are slow in throwing offsets, and care must be taken not to let the plants get any water until they show signs of doing so; patience is a virtue in great demand in the propagation of this section of the order. The slender-growing species are often grafted on stronger and faster growers, though care must be taken not to select for a stock one as celebrated for vigour as the scion is for want of it, or your labour will be

Seedling Echinocacti

in vain. As a stock for the smaller-growing Echinocacti, *Cereus tortuosus* or *C. colubrinus* is the best; for the larger, *C. peruvianus* and *C. gemmatus*. In grafting, care must be taken to cut the two ends rather convex than concave, as they are apt to shrink a little, which would cause a separation, and so spoil the graft; the scion must be tied firmly to the stock, taking care that the edges meet, or at least one of them. The best plan to insure against accidents is to put three sticks into the pot, and tie them together above the plant, thus causing a continual pressure from above." *Cereus flagelliformis*, or "Rat's-tail" Cereus, does well grafted on one of the slender-growing columnar species or *Pereskia aculeata* as a stock, and flowers more freely when so treated. "In grafting *Opuntia clavarioides* you may cut a cuneiform notch in the stock, and cut the scion to fit tightly; keep them firm with a stick on each side and a thorn run through the graft. Some of the smaller species of Cereus, as *C. tuberosus*, may be made pointed, with a corresponding hole in the stock—in all cases taking care not to disturb the plant when once grafted. When the operation is finished, the plants must then be put into a close frame, and laid on their sides until united, which they will do in about six weeks, when they may be placed upright, and gradually hardened off. Most of the species may be raised from seed, which should be sown as soon as collected, if possible, and put into a temperature of 60°. The young plants grow very slowly at first. When potted off they should be placed near the light. It is best to let them remain in the seed-pot until the following season, as they are very apt to damp if they are

potted off too soon. Seed collected abroad should be left in the pulp, which, being its natural protector, prevents the air acting on it, and drying it up; packed in a small tin box, it may be sent any distance without losing its vitality. The best flowering varieties are *Cereus speciosissimus*, and its varieties, as *C. Ackermanni*, *C. Jenkinsoni*, *C. splendens*, and others; these are the forms most commonly grown in cottage-windows. The genera Phyllocactus and Cereus contain many fine-flowering varieties.

"Hybridisation may be performed with ease, as the stamens and pistils are so very distinct, and the pollen produced in abundance. It may be preserved for some time if kept in a bottle hermetically sealed. I have not met with any successful attempt to cross Mammillaria with Echinocactus, or Opuntia with Cereus, though I know of no cause why they may not be, as the differences in the flowers are not differences of structure, but merely degrees of development,—such as a greater or lesser number of stamens or petals; or in the absence in some, and lengths in others, of the tube of the corolla, excepting that it may be that the pollen-tubes might be too strong for the distance they have to grow from the apex of the stigma, or *vice versâ*."

It may be well to point out here the fact that most of the large-flowered scandent species of Cereus, as *C. grandiflorus*, *C. (rostratus) hamatus*, and *C. Macdonaldiæ*, together with some of the columnar species, are night-flowering plants; and it will be necessary to watch the flowers closely to catch the stigma at its receptive period, as well as to prevent self-impregnation. Possibly it may be necessary to cut open the flowers before they expand, in order to make sure that the receptive surface is in a pure or virgin state. *Cereus speciosissimus* is one of the most brilliant-flowered species in the genus, and has already been used in hybridising with *C. oxypetalus*, *Phyllocactus Ackermanni*, and others. Many seedling or hybrid forms of *Phyllocactus* and *Cereus speciosissimus* have been raised in gardens; and among these *C. splendens* and *P. Gordoniana* are grown at Kew, and are remarkably ornamental in June when in bloom. The first-named has widely-expanded crimson-scarlet flowers, while the latter plant bears flowers of a soft rose colour. About 1870, Col. Charleton, of Farm Hill, Braddan, Isle of Man, bloomed a series of very beautiful hybrids, obtained by him as the result of crossing *Cereus speciosissimus* with *Phyllocactus crenatus*—a white-flowered species. Some of these seedlings were very handsome, bearing large flowers, the colours of which varied from white through all shades of peach, rose, and rosy-

pink, to a brilliant scarlet, with that wonderful flush of metallic purple which characterises *C. speciosissimus*. In hybridising large-flowered varieties with smaller kinds, care should be taken to select pollen from the smallest or shortest anthers; and in crossing small-flowered with large kinds, select the longest anthers. The *Phyllocacti*, *Cereus speciosissimus*, and others in the same group, and the valuable winter-blooming Epiphyllums, flower so readily and so copiously, that we can but wonder that they are so little cultivated; while there is yet a noble and wide field of labour for the intelligent hybridist in this order. Some of the Mammillarias vary very much in habit and colour, even when raised from seed, self-fertilised or fecundated with their own pollen; and there is no limit to the varieties and forms which cross-breeding may yet afford. *Echinocactus Ottonis* produces seeds very freely, as also do nearly all the Mamillarias. *Cereus Maynardi* is the name of a hybrid raised in this country in 1845 by Mr E. Kenny, gardener to Mr Maynard, and is said to have been the result of a cross between the white-flowered *Cereus grandiflorus* as the male parent and *C. speciosissimus*. The flowers are described as pale rose-flushed, with purple in the centre; and the flowers remain open as long as those of the female parent, which it resembled in habit. Is this plant in cultivation, or is it lost? In 1832 a hybrid from *C. speciosissimus* made its appearance on the Continent, and this was named *C. Guillardeti* by M. Jaques, presumably after the raiser. Mr R. Errington obtained a beautiful Cereus with large full flowers of a delicate rosy colour, each petal tinged with purple in the centre (see 'Gardeners' Chronicle,' 1844, p. 733). This was thought to be a hybrid between *Cereus longissimus* crossed with *C. truncatus*. About 1848, several beautiful hybrids were obtained by M. Grisard, who fertilised *Cereus Ackermanni* (itself a hybrid) with pollen from the "Rat's-tail" (*Cereus flagelliformis*). These were more or less cylindrical in habit, the stems being deeply fluted, the flutes or angles thus formed being more or less crenulate, as in the female parent. The flowers were very diverse in form—some tubular, others inclined more or less to the rotate form of the

Seedling Opuntia, three months old

female parent—and the colours different shades of rose and rosy crimson. Opuntias seed very freely, and their seeds germinate readily in heat. It would be interesting to attempt to raise hybrids between Opuntia and Cereus, or Opuntia and Echinocactus or Mammillaria. Some of the finer kinds of scandent-habited Cereus, as *C. (hamatus) rostratus*, *C. Macdonaldiæ*, *C. grandiflorus*, and the columnar species, which flower at long intervals, might be crossed advantageously with *C. speciosissimus*, or other kinds which flower annually. A very pretty effect may be produced wherever the strong-growing scandent species of Cereus are cultivated, by grafting on the stems small plants of *Echinocactus scopa* and its crested varieties, or some of the pretty silvery-spined Mammillarias.

A very fine hybrid between *Cereus grandiflorus* and *C. speciosissimus* was obtained by Messrs Davis of Wavertree, near Liverpool, previous to 1844, the individual blooms being ten inches in diameter, and of a soft rosy colour.

Herbert, in his 'Amaryllidaceæ,' p. 345 and 339, in speaking of hybrids, says: "Amongst the *Cacti* or *Cerei*, the prickly angular *Cereus speciosissimus*, the flexible *C. flagelliformis* or Whip-plant, and the unarmed *C. phyllanthocides*, are nearly the most dissimilar; yet they have produced mixed offspring, which readily bears eatable fruit of intermediate appearance and flavour. The fruit of *C. speciosissimus* is large, green, oblong, and well flavoured; that of *C. phyllanthocides* is small, purple, and very inferior; while the hybrid from the former has fruit of a medium size and taste. The cross from the former by *C. flagelliformis* has a short angular fruit, quite unlike that of the mother plant. The fertility of these crosses, and readiness to vary the appearance and taste of the fruit, though derived from such dissimilar parents, is one of the most striking results of our experiments. *Cereus grandiflorus* is also said to have crossed with *C. speciosissimus* at Colvill's; and *C. Ackermanni* (itself a hybrid) has bred with both *C. phyllanthocides* and *C. speciosissimus* at Spofforth; and I have been told that some of them have been also crossed with the very dissimilar *Epiphyllum truncatum*."

Mr Macintosh, nurseryman, Hammersmith, raised a beautiful new seedling *Phyllocactus*, a cross between the creamy-white *P. crenatus* and the scarlet *P. Ackermanni*. The flowers are of good size, the inner petals peach-coloured and the outer ones crimson-scarlet. In habit it appears to be intermediate between its parents, some of the shoots being crenated, others like those of Ackermanni. This plant first flowered in 1873.

Epiphyllums are a showy genus of dwarf-growing Cactaceous

plants, represented in our gardens by *E. truncatum*, an orange-scarlet-flowered species introduced from Brazil in 1818 (for a figure of *E. truncatum* as originally introduced, see 'Bot. Mag.,' t. 2562), and the more elegant-habited *E. Russellianum* (also from Brazil), introduced in 1839. Seeds are freely produced in small gooseberry-like fruits. The latter, however, are rarely produced unless the flowers are artificially fertilised, which is readily done, as the stigma is large and the pollen copious. Sow the seeds as soon as ripe in a well-drained pan of light sandy earth, having previously separated them from the pulpy fruit by rubbing in a fine dry cloth or towel. Placed in a genial bottom-heat of 60° to 70°, they germinate in a few weeks, and should then be placed on a sunny shelf in a dry airy atmosphere, as they are extremely liable to damp off if left in the moist propagating case.

The late Mr Wilbraham Buckley of Tooting, sometime manager to Messrs Rollison & Sons, gives the following concise account of the improvements effected in this genus by himself and others (see 'Florist,' 1868, i. 13, 14). Speaking of *E. Russellianum*, he observes: "This latter, although recorded as a variety of *E. truncatum*, is certainly a distinct species; for while the varieties of *E. truncatum* usually flower in November and December, the natural blooming period for *E. Russellianum* is the month of May.

"The late Mr Kemp of Mawbey House, Stockwell, tried hard to obtain a hybrid between *Epiphyllum truncatum* and *Cereus speciosissimus*, but could never succeed. He did, however, raise one good variety of *E. truncatum* named *magnificum*. Mr Bruce, also, the talented gardener at Collier's Wood, Merton, tried in vain to produce a hybrid between the *E. truncatum* section and *Phyllocactus speciosus* and others, although he obtained some beautiful hybrids in other sections. It may therefore be concluded that *E. truncatum* will not hybridise with the large-flowered species. More recently, some very beautiful hybrids were raised at the Tooting Nursery between *E. Russellianum* and *E. truncatum*, having the symmetrical form of the first, and flowering two months later than the last. The advantage gained by this cross was important, inasmuch as it extended the blooming time quite through the winter, to say nothing of the superiority of form which was secured.

"These varieties of *E. Russellianum* were: *E. R. rubrum*,* flower double the size of *E. Russellianum*, and of a bright rosy red; *E. R. cupreum*,* not so large as the last, of a coppery tinge, slightly suffused with purple; *E. R. superbum*,* in which the purple of *E. Russellianum* and the reddish tinge of *E.*

truncatum are beautifully blended. Added to these, a very pretty hybrid of the Russellianum section was raised by Mr Snow; gardener to Earl De Grey, called *E. R. Snowii*. No further addition appears to have been made up to the present time to this section.

"In the following list I have enumerated and briefly described the best and most showy seminal varieties of the *E. truncatum* section: *E. truncatum majus*,* larger than the species, and of a deep rose colour; *albo-lateritia*,* petals silky white, margined with brick red; *amabile*, white and purple; *aurantiacum*, reddish orange; *bicolor*, white and rose edged; *coccineum*,* deep scarlet; *cruentum*,* dark purplish red; *magnificum*, large, bright rose and white; *purpureum*,* deep purple, nearly self-coloured; *roseum*,* bright rose; *rubro-tinctum*, white and purplish red; *Ruckerianum*, purplish red, tinged with violet; *splendens*,* deep rose; *spectabile*, white, with purplish margin; *spectabile-carminatum*, white, with reddish margin; *salmoneum*, salmony red; *tricolor*, deep reddish purple and white; *violaceum*, silvery white, with light purple margin; *violaceum grandiflorum*, like the last, but larger; *violaceum superbum*, deep purple and white."

Those marked with an asterisk were raised from seed by Mr Buckley in the Tooting Nursery. Mr T. Brown, of the Exotic Nursery, Tooting, has also raised some very fine seedling Epiphyllums. Seedlings flower the third or fourth year; and it would be an interesting experiment for amateurs, and others having time at their disposal, to endeavour to obtain a hybrid between *E. truncatum* and *Cereus flagelliformis*; and it is more than probable that a distinct and useful progeny would be the result. In order to accomplish this, the former would need retarding, as *C. flagelliformis* does not usually flower till late in the spring or in the early summer months.

Epiphyllums root freely from cuttings of the stem or leaf; and the cuttings may either be a single leaf or a portion of a plant three or four inches in length. They are also easily propagated by grafting on *Pereskia aculeata* or its allies, or on *Cereus speciosissimus* as a stock.† The texture of both stock and scion being of a cellular or fleshy consistence, they unite very readily. *Pereskia* cuttings root easily; and when 12-15 inches in height, and as thick as a pencil, they are fit for working. Some operators head off the stock and split it with a sharp knife, so

† When Epiphyllums are grafted on the succulent stems of *Cereus* or other *Cacti* as stocks, not only do the cellular tissues of stock and scion unite, but the scions frequently root into the tissues of the stock, and so derive additional nutriment.

as to form a cleft an inch or rather more in length, into which a small piece of the Epiphyllum, cut wedge-fashion at the base, is inserted as a scion and secured with bast. An old leaf of good substance, with one or two young ones at its apex, makes a capital graft. Others cut off the top of the stock in a wedge-shaped manner, and split the base of the scion to fit over it saddle-fashion. Both methods are equally successful. The *Cereus speciosissimus* makes the stoutest and best stock for large specimens; and if planted out and trained up rafters or the back wall of a warm conservatory, and grafted all over with different-coloured varieties of Epiphyllums, the effect obtained is very pleasing. To insert grafts in the Cereus stock, a sharp budding-knife is plunged in the side so as to make a clean incision, into which a scion, cut wedge-shaped at the base, is inserted and secured with a spine of the Cereus; or a slender splinter cut off a deal label answers just as well, no tying being required,—the plants being placed in a close case for a week or two until a junction is effected. Scions take well on any of the *Opuntias* or "Indian Figs," as well as on all the *Phyllocactus*, columnar and scandent *Cereus*, and even on *Echinocactus* and *Echinopsis*, but for all practical purposes *Cereus speciosissimus*, and *Pereskia aculeata*, are good stocks. A writer in the 'Deutsche Garten-Zeitung' for March 1876, recommends *Pereskia calandriniæfolia* as the best stock for Epiphyllums, and adds that the German florists in the neighbourhood of Dusseldorf have used it exclusively for several years. It is as easily propagated as *P aculeata*, and makes a stronger growth; it is thus better able to support the heavy succulent growth of the Epiphyllums grafted upon it than *P. aculeata*. In short, this stock answers every purpose for which the *Cereus speciosissimus* is used, and being more woody, it is not so liable to rot off if neglected.

It is by no means settled which is actually the best stock for Epiphyllums—*i.e.*, whether *Cereus speciosissimus* or the *Pereskias;* and Mr D. E. Fish thus writes on this subject in the 'Florist,' 1869, p. 256:—

"Grafted plants are the most popular, and the ease with which they will take on almost any stock has also favoured the practice of grafting, while it probably may have prevented us discovering the best possible stock. I believe they will grow on any Cactus, but I have chiefly used only two stocks. The *Cereus speciosissimus*, while one of our grandest Cactuses in itself, seems formed by nature for a support to all the weak members of its glorious family. It is distinguished by three of the most vital characteristics of a good stock—it is strong, it

grows freely, and it is long-lived. It seems made to carry a burden. It will support almost any weight of Epiphyllum at any desired height with evident ease and conscious dignity. And then it grows with the freedom of a weed and the vigour of a giant; and who ever heard of its dying? It can scarcely be destroyed, unless by frost; and it will endure a temperature as low as 40° Fahr. with impunity, which is 5° lower than the Epiphyllum likes to be subjected to. The strength of this noble Cereus enables it to scorn the help of artificial props. Worked on the top of this Cereus, the Epiphyllums form beautiful standard or umbrella plants; inserted all the way up the stems, they can be made into nice, narrow pyramids. There is one objection to this stock—more theoretical, however, than practical. Its natural period of blooming is four or six months later than that of the Epiphyllum. Still it never seems unwilling to be forced into growth at the demand of the scion, nor, as far as I have observed, has it ever refused to supply food to meet the wants of its adopted children.

"Still, for my large plants I prefer a different stock, which lacks all the robustness and the strength of this grand Cereus. This is the *Pereskia* or *Peirescia aculeata.* It roots and grows freely, and unless for stocks, is of no use whatever. The Epiphyllum takes readily upon it, although not so freely as on the Cereus. The Pereskia has but little strength in itself; its merit lies in its pliability. I have also seen it used for a dwarf standard; but the plants require other support, and it is not equal to the Cereus for such purposes."

The Chimonanthus Family (*Calycanthaceæ*).

A small group of hardy deciduous shrubs, natives of North America and Japan, and represented in gardens by *Chimonanthus fragrans,* and its varieties "grandiflora" and "præcox," and by one or two species of *Calycanthus.* The flowers of all the species are peculiarly fragrant, and the bark of *Calycanthus floridus* is used as a substitute for cinnamon in North America. Cuttings of these plants do not strike root freely, and it is best to trust to layers—or better still, to seeds when they are obtainable. It would be exceedingly interesting to know if *Chimonanthus* will succeed grafted on *Calycanthus,* or *vice versâ;* or whether these plants could not be more readily multiplied by herbaceous cuttings made in heat or by grafting on the roots, a method which is easily tested and very successful in the case of Ipomœas, Aralias, Conifers, and many

other plants which are difficult to increase by cuttings. In order to obtain seeds of the *Calycanthus* or the *Chimonanthus*, artificial fertilisation is necessary; and advantage should be taken of a fine sunny day for this purpose. It is curious to notice that the flowers of this plant, like those of Orchids and other plants requiring insect agency to insure fertilisation, are of a wax-like consistence, and endure for a long time in a fresh state.

THE BELL-FLOWER FAMILY (*Campanulaceæ*).

A large family of herbaceous plants or low shrubs, often characterised by a milky juice. They are chiefly known in temperate parts of the world, especially North Asia, Europe, and North America. The principal genera are *Jasione*, *Canarina*, *Platycodon*, *Wahlenbergia*, *Roellia*, *Michauxia*, *Campanula*, *Specularia*, *Trachelium*, *Adenophora*, and one or two others. One of the curious points about Bellworts is the style, which is club-shaped, and, like those of Composites and Lobeliads, clothed with stiff, sub-erect hairs, the object of which is, doubtless, to brush out the pollen from the anthers. Lindley (see 'Veg. King.,' p. 690) observes that Adolphe Brongniart has studied these hairs; and this acute observer found that they were retractile, like the tentacula of snails or the hairs of some annelides, and not deciduous, as had previously been supposed. "It appears," says Lindley, "that at the time of the expansion of the flower, the hairs which had previously projected and swept out the pollen from the anthers are drawn back into certain cavities lying at their base, the upper half sheathing itself into the lower half as it is by degrees withdrawn" (see 'Ann. des. Sc. Nat.' (2 ser.), 12, 244; and 'Ann. Nat. Hist.,' viii. p. 86). This is another of the numerous contrivances designed to facilitate occasional cross-fertilisation; and whenever these natural means of securing cross-fertilisation are observed, the hybridiser is pretty certain to meet with success.

Campanula Houttei is one of the best of all hybrid Campanulas, but I cannot discover its parentage. *C. Hendersoni* is said to be the result of a cross between *C. turbinata* and *C. alliarifolia*.

C. Smithii is doubtless a natural hybrid, it having originated as a chance seedling in a frame where *C. fragilis* and *C. pumila alba* had been grown (see 'Florist,' 1875, p. 209, for coloured figure, &c.) Numerous fine seminal single and semi-double forms of *C.* (*Platycodon*) *grandiflora* have been raised in

Continental gardens, the colour varying from white to dark-blue (see 'L'Horticulture Belge,' 1875, p. 241).

THE HOP AND HEMP FAMILY (*Cannabinaceæ*).

A small order of herbaceous plants, mostly natives of temperate parts of the Old World, and represented in our gardens and fields by the common Hemp (*Cannabis sativa*), a well-known fibre-producing plant—and the Hop plant (*Humulus lupulus*), a graceful climbing plant, from the bracts and seeds of which Hops used by brewers are prepared. Hemp is an annual plant very easily raised from seeds sown in heat in March, or in the open air in May or June. Hops are readily multiplied by division. The plants in this order bear male and female flowers on separate individuals, so that

Common Hop (male and female).

both sexes must be grown in close proximity if fertile seeds are desired. In rare instances, however, the common Hop plant produces male and female flowers together, being then monœcious instead of diœcious, as is normally the case; and it has been suggested that by saving seed from these monœcious plants, a race bearing male and female flowers together might be obtained. The following interesting allusion to this subject is from a recent number of the 'Gardeners' Chronicle:'—

"I enclose a specimen of the male Hop with apparently female flowers at the tips of the branches.

"There are other male plants in the same ground, but I have not seen any other instance of this peculiarity. The

whole Hop hill grows in the same way. If we obtain seed, might not it be possible to select a strain of Hops which are uniformly monœcious on the same plant? [Certainly.]

"The Hop ground is in Boughton Monchelsea, facing south, very warm, and of strong rich soil. We are the more interested in this specimen, as many years ago a similar instance was brought under our notice by Mr Masters of Canterbury, and which formed the subject of an interesting notice from his pen in our volume for 1852, p. 597. The case is interesting with reference to the doctrine of parthenogenesis. The Cœlebogyne, asserted to produce seeds without the formation of male blooms, has now frequently been seen to produce flowers of both sexes. We saw an instance of this lately in the herbarium of Professor Baillon of Paris."

THE HONEYSUCKLE FAMILY (*Caprifoliaceæ*).

A small order of beautiful and interesting hardy plants, represented in our pleasure-grounds and gardens by *Abelia*, *Linnæa*, *Leycesteria*, *Caprifolium*, *Lonicera* (Honeysuckle), *Viburnum* (Guelder Rose), *Sambucus* (Elder). Nearly all the species are more or less fragrant, and are for the most part readily propagated either by herbaceous or hard-wooded cuttings, or by seeds when procurable, as in *Sambucus*, *Viburnum*, and *Lonicera*. The vitality of Elder-berry seeds is very great, as they germinate freely, even after having been boiled for wine-making purposes; and this is one of our native plants which, like the Currant and Gooseberry, is largely distributed by birds. *Linnæa borealis* is readily increased by division, and *Leycesteria* and *Abelia* by layers or cuttings—herbaceous cuttings in a close case in spring, and hard-wooded cuttings on a north border or under a hand-light in autumn.

Lonicera (Woodbines or Honeysuckles).—A well-known genus of shrubs, often scandent or twining, and bearing showy and often fragrant flowers. Our native *L. periclymenum* is one of the most deliciously fragrant of all plants. Loniceras are readily propagated either by seeds, cuttings, or layers. Seeds are freely produced by *L. etrusca*, *L. caprifolium*, the common Woodbine, and others; and these might be used as seed-bearing parents, and considerable improvement effected by crossing them with pollen from *L. japonica*, *L. flexuosa*, *L. sempervirens* (one of the finest of all hardy Honeysuckles), *L. pubescens*, and others. Mr Ingram, when at Frogmore, raised

several pretty seedling woodbines, and among others *Lonicera japonica hybrida*, a hybrid—its parents being *L. japonica* and *L. flexuosa*. *L. brachypoda aurea-reticulata* produces fruit now and then in our gardens, and by using pollen from this plant to fertilise the evergreen species as *L. sempervirens*, &c., a race of golden-variegated varieties might possibly be obtained. The Chamæcerasus group have already been improved by hybridising, and numerous forms of *L.* (*Chamæcerasus*) *tartarica* have been raised in Continental gardens by M. Prevost and others; and *L. alpina*, *L. xylosteon*, and one or two other species, might be used for crossing with these. Many seminal varieties of *Lonicera tartarica* (see 'Revue Hort.,' 1868, p. 392) have been obtained by M. Billiard of Fontenay-aux-Roses, and the following four varieties are figured in the work just cited: *L. tartarica speciosa*, bearing large rosy flowers; *L. tartarica elegans*, flesh colour; *L. tartarica bicolor*, white and rosy lilac; *L. tartarica gracilis*, white. In addition to those named, M. Billiard has raised numerous other seedlings scarcely less attractive.

Viburnum (Gueldres Rose, Laurestinus).—A rather extensive group of shrubs, natives of Europe, temperate Asia, and N. America,—two species, *V. lantana*, the "Wayfaring tree," and *V. opulus*, or "Gueldres Rose," being natives of Britain. *V. tinus*, or *Laurus tinus*, as it was formerly called by botanists, whence its now popular name, is one of the most handsome of our winter-flowering shrubs, and is a native of S. Europe, and in Corsica it forms extensive woods. The Gueldres Rose, or "Snowball tree," as it is popularly called, and several other kinds, owe the beauty of their blossoms to an abortive development analogous to that in the conspicuous flowers of Hydrangeas; and if some inquiring mind can hit on the primary cause of this production of enlarged and infertile florets in these groups, we may possibly be enabled to add numerous other showy plants to our gardens. One of the finest species is *V. macrocephalum*, which rivals the Hydrangeas in size and beauty. These plants may be propagated by cuttings of the young wood in autumn, or by layers, and by seed when it is produced. Seedlings of *V. lantana* when a year old form excellent stocks for the other kinds. Graft by splice-grafting or veneering on or below the neck of the stock under glass. *V. macrocephalum* succeeds well on the Laurestinus as a stock, cleft-grafting in this case being most successful.

The Carnation Family (*Caryophyllaceæ*).

A large group of herbaceous plants having opposite leaves and tumid or swollen joints, and represented in our gardens by Pinks, Carnations, Sweet-Williams, and a few other popular flowers, mostly hardy. Even the species which are found near the equator grow at such high altitudes as to be hardy in northern latitudes. As a rule, all the plants in this group seed most profusely, and their propagation by seeds, cuttings, layers, or division, is very easy. The principal genera found in gardens are *Alsine*, *Arenaria*, *Stellaria*, *Cerastium*, *Dianthus* (Pinks), *Saponaria*, *Gypsophila*, *Silene*, *Viscaria*, *Agrostemma* (Corn-cockle), *Lychnis*, *Cucubalus*, and others. Artificial fertilisation and hybridisation is very easy in this group, hence the great variety of Pinks, Cloves, Carnations, and Sweet-Williams in our gardens; and even in a state of nature hybrids are found. Thus numerous hybrids intermediate between *Dianthus monspessulanus* and *D. Seguieri* are found on the mountains of Auvergne. *D. sinensis* (*D. Heddewigii*, Hort.) and *D. barbatus*, together with *D. caryophyllus*, are also in an extreme state of seminal variability, partly induced by cultivation, and the tendency further augmented by hybridism and cross-breeding. It is a common occurrence to see different-coloured flowers in the same inflorescence of *D. barbatus*, these being cases of reversion to one or other of the characters possessed by the former parents of the individual. About 1834 M. Pépin, a Continental florist, obtained hybrids between *Lychnis* (*Agrostemma*) *flos-jovis* and *L. coronaria*, the flowers being large, and produced in large corymbose clusters. The genus *Linum* is sometimes included here, and these being mostly annuals, are freely multiplied by seeds. *L. trigynum*, a showy yellow-flowered greenhouse shrub, is readily propagated by cuttings.

Dianthus (Pinks).—A very popular genus of, for the most part, hardy perennials, of which our garden Pinks, Carnations, and Sweet-Williams, are well known and deliciously fragrant examples. *D. sinensis*, or Chinese Pink, is an annual of which there are innumerable varieties, easily propagated by sowing seeds in autumn in a pit or frame, or in the open beds or borders in April. The Carnation and the common garden Pink are both supposed to have originated from *D. caryophyllus*, or Clove-scented Pink; but it is difficult to say with any degree of certainty exactly what plants were the parents of these old garden flowers, since they have been

admired and cultivated by English florists during the past three centuries.

Pinks and Carnations are among the oldest of all florists' flowers; and faithful old Parkinson, at page 12 of his 'Paradisus,' in discoursing on them under the head of what he calls English Flowers, observes: "But what shall I say of the Queen of delight and of flowers, Carnations and Gilloflowers, whose bravery, variety, and sweet smell joyned togeather, tyeth every one's affection with great ernesstness both to like and to have them? Those that were known and enjoyed in former times with much acceptation are now for the most part lesse accounted of, except a very few; for now there are so many other varieties of later invention that troubleth the other both in number, beauty, and worth." Among the varieties which he quaintly says "troubleth the others" are the Red and Grey Halo—the old Carnation differing from them both—the Granpere, the Dover, the Oxford, the White Carnation or Delicate, and many others. "But there is another sort of great delight and variety called the Orange Tawny Gilloflower, which for the most part hath risen from seed, and doth give seed in a more plentiful manner than any of the former sorts, and likewise by the sowing of the seed there hath been gained so many varieties of that excellent worth and respect that it can hardly be expressed or beleeved." These last were in all probability Picotees, or Yellow-grounded Carnations. "Pinks, likewise, both single and double, are of much variety, all of them very sweet, coming near the Gilloflowers, Sweet-Williams, and Sweet-Johns, both single and double, both white, red, and spotted, as they are kinds of wilde Pinks, so far their grace and beauty help to furnish a garden." For excellent old woodcut figures and quaint descriptions of Carnations and Pinks cultivated in 1629, see Parkinson's 'Paradisus in Sole,' p. 306-317.

Seeds.—New varieties are raised from seeds, which are freely produced by healthy plants. If a double Pink or Carnation flower be examined, the feather-like tips of the stigma will be seen in the centre of the flower, and these should be fertilised by pollen taken from a single or semi-double variety of good habit and colour. If the seed-bearing plants are out of doors, fertilise the first two or three blooms, which are always the finest, having previously thinned out all the other flower-stems and the superfluous buds on those left to bloom. By doing this the seed will be finer, and also ripen much earlier. In wet, cold localities, the seed-bearing plants may be grown in pots plunged in ashes or cocoa-nut fibre in a

cold frame, the lights being drawn off except at nights or in cold, wet weather; for one of the principal difficulties experienced in raising the seeds of Pinks and Carnations is their proneness to be affected by damp. Sow the seeds in August as soon as ripe, or in the following May, in pans of well-drained light rich sandy compost, barely covering the seeds with earth, and giving them a slight bottom-heat of about 65°, which induces them to grow quicker and all at once. Prick off the seedlings into boxes when an inch or so high, and when large enough plant out in deeply-dug, well-manured nursery beds, the soil of which on the surface should be finely pulverised, so as to allow the young seedlings to root freely and make a strong growth before winter. The following is Mr Ball's advice to raisers of Pinks, Carnations, and Picotees: "It is very essential to have a few good, healthy, strong-growing selected varieties of the very best kinds, choosing those that produce but moderately full or rather thin flowers, as these generally produce most seed, and the newer the varieties selected the better, as recent seedlings of all florists' flowers generally produce seed in greater abundance than the older varieties. The plants may be either grown in pots or in the open ground, but pot culture is preferable As soon as the flowers begin to expand they should be protected from the rain, either by putting them into a greenhouse or by placing glasses over them, but give them plenty of air, and allow them to have the sun, as plants bloomed under a covering in the shade produce little or no seed, neither do those that are entirely exposed to the weather, because the occasional showers of rain and the night dews keep the base of the petals continually moist, which, as a consequence, leads to mouldiness and decay. It is a good plan, when the bloom is over, to extract the decayed petals, taking particular care in doing so not to injure the two stigmas or arms of the style, which appear like horns projected from the seed-vessel. The plants should not be layered until the seed becomes ripened, because this operation will most certainly reduce, if not quite destroy, the seed crop.

The seed generally becomes ripe about the end of August. Care should be taken not to gather it until it is quite ripe, and it should be kept in the seed-vessel or pericarp until the time to sow it, which is about the first week in May.

Herbert (see 'Herb. Am.,' p. 356, 366) says: "I am not aware at what period the beautiful Mule Pink, which is common in our gardens, made its first appearance, nor through whom or in what manner it was obtained, but it was probably the

produce of an accidental intermixture of a florists' Pink with a crimson Sweet-William."

In Carnations the seedlings have a great disposition to follow the colour of the seed-bearing parent.

An old garden form named Fairchild's Mule is supposed to be the result of a cross between a *Dianthus superbus* and *D. caryophyllus* (see Darwin, 'Loves of the Plants,' p. 216). For figures of the earlier-introduced species of *Dianthus*, see the earlier numbers of the 'Botanical Magazine.'

Layers.—The best florists' or exhibition varieties of Pinks and Carnations are generally propagated by layers, July or the beginning of August being the best time. Layering is a simple operation, and a sure one if neatly performed. Take a basket of fine sandy earth, a sharp budding-knife, and a quantity of small pegs made of an old birch broom or dried stalks of the common Brake Fern. Select the best-developed shoots for layerings, and stroking up the leaves in the left hand, just remove their tips with the knife, and then trim off the lower leaves. Select that part of the shoot below the terminal tuft of leaves, and make a transverse but sloping cut about half-way through a joint; then bend down the shoot to the surface of the bed, and secure it with one of your little pegs; then cover it with soil from the basket, leaving the ends of the shoots only free, and the operation is complete. Where several shoots are layered on the same plant or "stool," the earthing-up process may be left until the slitting and pegging operations are finished. When layering is performed early—say in July—the plants (layers) become well rooted and ready for potting off or planting out before winter. Shortening the tuft of leaves serves no useful purpose except that it enables the cultivator to see the future growth of the layered branch, and so judge of the root formation going on below the soil.

Pipings or Cuttings.—This method of propagation is generally adopted for "Tree Carnations," now so largely cultivated as cool greenhouse plants in most gardens, as well as for the ordinary varieties of Cloves, Picotees, and Pinks. In Messrs Low's nursery at Clapton, where hundreds of Tree Carnations are propagated every year, the common practice is to pull off the ends of the shoots and insert them at once in pans of light earth, sand, and leaf-mould, placed in a moist atmosphere on a gentle bottom-heat; and, so treated, failures are very rare. Hardy Pinks and Carnations may be treated in the same way, or the shoots may be cut below the third or fourth joint with a sharp knife. Have ready pans of light compost, well drained and covered with a layer of sand, into which prick the cuttings,

or pipings as they are technically called, after which settle the sand and earth about them by watering through a fine-rosed can, afterwards placing the pans on a gentle bottom-heat of 50°-60° in an ordinary pit or frame. Pipings put in on a layer of sand on a shaded open border and covered with a common hand-glass strike well, although not so quickly as those on bottom-heat. Pipings or cuttings may be taken off in July or August. Pinks are ready still earlier.

The Sweet-William (*D. barbatus*) has been much improved of late years, and is among Pinks what the Auricula is among the Primroses, its flowers being borne in globose heads. It bears seeds very abundantly without artificial fecundation, and these, if saved from a good strain, give excellent results. This plant is also readily propagated either from cuttings in June or July, or by division in autumn or spring. Cuttings strike freely in a cool shady border covered with a common hand-light. The Sweet-William is supposed to have originated from *D. pseud-armeria*, a hardy, purple-flowered perennial, native of dry stony places in Tauria (see 'Bot. Mag.,' t. 2288). Many of the Alpine Pinks or hardy mountain species of Dianthus seed freely, and the seeds grow well sown in pans of moist peat and loam, mixed with grit and lumps of sandstone. A cool shaded frame suits them best. The quickest and readiest plan of propagating nearly all the hardy species is, however, by careful division, either in spring or immediately after flowering. To get the Sweet-William in fine form, fresh seedlings should be raised every year: the seed should be sown in the open ground thinly, early in May; by so doing it germinates rapidly under the influence of the summer's increasing heat, and comparatively large plants are thus ready for planting out in the autumn. If, however, the seed be sown in a box or pan, or in any confined space, the seedlings should be planted out into some vacant piece of ground as soon as they are large enough to be moved with safety, and then they may be transferred to their permanent places at leisure in autumn.

Dianthus barbato-superbus is cited by Dr Clos (see 'Belgique Horticole,' 1873, p. 254) as a hybrid between *Dianthus superbus* and the Sweet-William; and the Montpellier Pink (*D. monspessulanus*) and the Chinese Pink (*D. sinensis*) have also produced hybrid offspring in Continental gardens. Hybrids have also been produced between *D. Seguierii* and *D. monspessulanus;* and the common Sweet-William and the old Clove Pink cross pretty freely. By crossing *D.* (*sinensis*) *Heddewigii* with some of the Clove Pinks, Sweet-Williams, or with some of the beautiful Alpine species, we might originate new races of

florists' varieties and very desirable ornamental plants. It has often been thought that the relative size of the pollen-grains determined to some extent the degree of facility with which hybrids in the same genus might be produced; and Gærtner, in alluding to this subject, remarks that the pollen of *D. caryophyllus* fructifies *D. superbus*, although the pollen of the latter is much smaller than that of the former; but he adds that *D. barbatus* and *caryophyllus* unite imperfectly, whereas *D. barbato-sinensis* easily hybridises with *D. caryophyllus* ♂, *D. sinensis* being in this case the intermediate member.

It was observed before that the difference of the number of seeds is proportionate to the degree of elective affinity. Gærtner avails himself of this as a means of estimating this degree in the several species. It may not be uninteresting to give a table of the affinities of a single species, though we cannot enter upon various questions which arise as to the propriety of this mode of estimation. Taking, therefore, normal impregnation as unity, we have—

♀ Dianthus barbatus ♂ by its own pollen	1.0000
superbus	0.8111
japonicus	0.6666
Armeria	0.5333
barbato-Carthusianorum	0.3111
sinensis	0.2600
collinus	0.2333
deltoides	0.2222
sinensis latif. Schr.	0.1354
Carthusianorum	0.1111
prolifer	0.0333
virgineus	0.0111
pulchellus	0.0096
arenarius	0.0084
diutinus	0.0033

Lychnis.—A showy genus of hardy herbaceous plants or annuals, represented in our gardens by *L. dioica fl.-pl.*, *L. chalcedonica* (see 'Bot. Mag.,' t. 257)—a tall-growing herbaceous perennial, bearing flowers of a vivid "Tom Thumb" scarlet. There are white and rosy flowered varieties of this fine old species, and a double-flowered form has been grown in our gardens since the time of Parkinson (1629), who, in the portrait which prefixes the first edition of his celebrated 'Paradisus,' is represented bearing this flower in his hand. *Lychnis coronata* (see 'Bot. Mag.,' t. 223) is a very handsome half-hardy species from China and Japan, bearing large flat scarlet flowers, the size and shape of *Dianthus Heddewigii*. This was introduced in 1774; and being now procurable, it might be made

one of the parents of a very distinct and beautiful race, especially if intercrossed with *L. coronata alba*, a variety with milk-white flowers. Beautiful hybrids have been already obtained. Thus *L. Haageana* is the offspring of *L. fulgens* fertilised with pollen from *L. Sieboldii*. In 1843 Mr. Pépin recorded the production of a hybrid between *L.* (*Agrostemma*) *flos-jovis* and *L.* (*Agrostemma*) *coronaria;* and this is described (see 'Annales de Flore et du Pomone,' 1843) as a very handsome plant, with large and brilliantly-coloured flowers, the plant being intermediate in habit.

Much fallacy has arisen with regard to the supposed frequency of the union of different genera of the same family, in consequence of concluding that union had taken place because apparently perfect seeds had been produced, without waiting to examine whether they were really fertile, and in case of their germination, observing the produce. Gærtner had been led into error in this respect during the earlier part of his studies; and a long series of experiments, undertaken in consequence of the discovery of his error, produced but a single successful result—namely, the union of *Lychnis diurna* with *Cucubalus viscosus*. He had, however, during the course of other experiments, effected a union between *Lychnis diurna* ♀ and *Silene noctiflora* ♂, as also with *Agrostemma coronaria*. The union of *Lychnis vespertina* ♀ with *Cucubalus viscosus* ♂ is much more difficult than that of *Lychnis diurna* ♀, and the hybrid type is entirely different, which gives the clearest proof of the really specific difference between the two. In the case of *Lychnis* and *Agrostemma*, though seeds were formed containing apparently perfect embryos, not a single one germinated, showing some weakness of constitution in the result of the union, of which many instances occur in these researches. Union had certainly taken place; for had the seeds been due to the access of homogeneous pollen, there could be no reason why they should not have germinated, assuming them to be perfectly developed.

THE PERUVIAN BARK FAMILY (*Cinchonaceæ*).

A large order of ornamental, economic, and medicinal plants, principally natives of the tropics. In northern countries some of the stellate-leaved species are found; the most southern example of the family being the pretty little red-berried *Nertera depressa*, found in the Strait of Magellan. Coffee (*Coffea arabica*) and the different species of *Cinchona* or Peruvian Bark, from which quinine is extracted, are perhaps

the most valuable of all the economic products; but numerous other plants in this order afford medicinal extracts more or less valuable. In our gardens the following genera, among others, are generally met with, and as a rule are readily propagated by cuttings of the partially-hardened young wood in bottom-heat, or by seeds sown in a temperature of 70°-80°: *Coprosma*, *Cephaëlis* (Ipecacuanha), *Coffea*, *Pavetta*; *Ixora*, *Nertera*, *Pentas*, *Rondoletia*, *Bouvardia*, *Luculia*, *Cinchona*, *Higginsia*, *Coccosypselum*, *Randia*, *Gardenia*, *Mussænda*, *Burchellia*, and many others.

Bouvardia.—A genus of dwarf-growing and free-blooming Mexican shrubs, much grown in gardens for cut flowers during winter. *B. triphylla*, a scarlet-flowered, summer-blooming plant, was the first species introduced to this country, having been cultivated since 1794; and this was followed by *B. versicolor* (1814), *B. longiflora* (1827), *B. splendens* (1834), and *B. angustifolia* (1838). All the species or varieties are readily propagated by inserting herbaceous or partly-hardened cuttings of the young growth in spring, or by cutting the thicker portions of the roots into lengths of an inch, and sowing them in pans of light earth like seeds. Placed on a genial bottom-heat of 70°-80°, they soon emit roots and develop adventitious buds. Seeds are readily obtainable from well-grown plants; but this method is rarely worth adopting, unless the object is to raise new and improved varieties, in which case the flowers must be carefully hybridised.

Mr Baird of the Wellington Nursery, a skilful hybridist, gives the following history of the hybrids and sports raised in this genus: "In 1855, the late Mr Parsons, of Brighton, was very successful in raising some beautiful hybrids between *B. longiflora* and *B. leiantha*, using the latter as the male and the former as the female parent. The following four were in commerce in 1857—viz., *Rosalinda*, *Laura*, *Oriana*, and *Hogarth*. Of these the last is by far the best, being bright scarlet. *Laura* is at times inclined to sport in colour; for example, last year I had flowers of it the exact counterpart of those of *Hogarth*; while some trusses of others have been pink, scarlet, and other shades of these colours. In 1869, a very fine sport from *B. Hogarth*, named *B. elegans*, was imported from America—a remarkably robust and free-growing kind, its trusses and individual florets being nearly double the size of those of *Hogarth*, while in colour it is bright scarlet. In the autumn of the year just named both *Hogarth* and *B. longiflora* were crossed with *B. jasminiflora*, and from the former was obtained Queen of Roses, the first Bouvardia with coloured flowers that were sweet-scented. In

1871 I had both *B. Humboldtii* and *B. jasminiflora* in bloom. I therefore crossed *B. jasminiflora* with the pollen of *B. Humboldtii*, and the result was about twenty seedlings, from among which the two following were selected for distribution in 1873—viz., *B. Humboldtii corymbiflora* and *B. jasminiflora longipetala*. I also, at the same time, fertilised *B. elegans* with *B. jasminiflora*, the result being *umbellata carnea*, *umbellata alba*, and *candidissima*, all of which were good, and were sent out in 1873. *B. longiflora flammea*, also obtained from this cross, is one of the very brightest of its colour, which is salmon-tinted scarlet; but occasionally some of its petals will sport to pink, especially if grown in too cool a temperature. From the cross just named was also obtained *B. Bridal Wreath*, a fine hybrid, having the vigorous branching habit of *B. jasminiflora*, with finer flowers and much larger trusses; likewise *B. alba odorata*, a dwarf, compact kind, with flowers of great substance in the form of very short tubes, and, as the name implies, very odorous. The flowers, too, are very persistent, often remaining on the plant till quite dead; they are of pearly whiteness, resembling white marble. The four varieties just described were 'sent out' in 1872. In that year *B. Davisonii*, a beautiful white sport from *Hogarth*, and exactly like it in growth, was introduced from America. *B. Maiden Blush*, a soft, rosy, blush sport from *B. Davisonii*, was obtained in 1873, and sent out the year following. *B. bicolor*, a seedling from *B. flava*, crossed with *B. elegans*, has a habit like that of the latter, and very distinct-looking purple flowers with rosy-pink lobes, slightly tipped with white, and a centre or eye also of that colour; this variety was sent out in 1874." *B. jasminiflora flavescens* is a hybrid raised by M. V. Lemoine of Nancy, and sent out in 1875. It is a seedling from *B. jasminiflora* fertilised with pollen of *B. flava*, and bears clear canary-yellow flowers in umbels like those of the seed parent.

Bud-variation is of very frequent occurrence in the case of Bouvardias, and, as one would naturally expect, it is rarely observable except in hybrid or cross-bred seedling forms, and then the dissociation of the hybrid or mixed characters is often only partial; and the result of this is a new variety, different from the hybrid and its two parents. The following lucid remarks on this subject are from the 'Social Science Review' for 1872: "Any plant produced from seed requiring for its development the contact of the pollen-tube with the ovule or germinal vesicle, must be held to have mixed characters, and more markedly so in the case of unisexual flowers, either monœcious or diœcious. From this point of

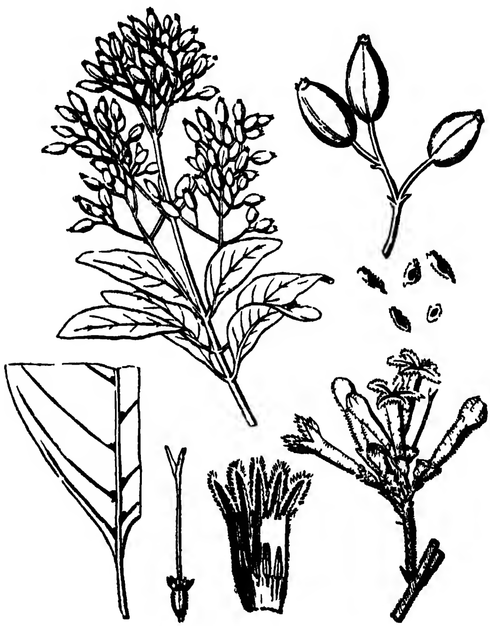
view a case lately recorded by Mr Meehan becomes very significant. That gentleman relates that he obtained cuttings from *Bouvardia leiantha*, a diœcious plant, producing its male and female flowers on different individuals. It is not stated whether the cuttings were taken from a male or female plant; but it is stated that some of these cuttings produced male, others female, plants, and yet all were taken from a plant of one sex only. So, too, it is well known that certain unisexual trees will in some seasons produce male flowers only, in other seasons female flowers only, and *vice versâ*. But dissociation of mixed characters will not account for all the cases of bud-variation. Very often we have no evidence at all of previous hybridisation or crossing; or even when such has existed, the form produced is not like that of either of the supposed progenitors. Such cases as the Fern-leaved Beech do not seem explicable by either hypothesis. The Sugar-cane, which rarely, if ever flowers, and hence offers no opportunity for hybridisation, nevertheless produces new varieties by means of bud-variation. Potato-tubers, again, vary greatly often on the same plant, but these may be the result of former crossing. A case related by Mr Meehan, in the Sweet Potato (*Convolvulus batatas*), is, however, not open to this objection. The plant in question, it appears, never flowers in the Northern States of America, and yet it has been known to produce tubers of two distinct varieties—the 'Red Bermuda' and the 'White Brazilian'—on the same root."

Cephælis.—A genus of Brazilian plants represented in our botanic gardens by *C. ipecacuanha*, a medicinal shrub; and, like *Cinchona*, to which it is botanically related, it may prove to be a valuable plant, well worth culture in some parts of N. India. Its properties are emetic, and it acts on the skin and bronchial passages. Propagated by cuttings in a high moist temperature, or by girdling the branches and surrounding the cut parts with soil or damp moss. As it is a plant of extremely slow growth, it cannot be increased in quantity by either of these methods; and Mr M'Nab, of the Edinburgh Botanic Garden, very cleverly succeeded in propagating the plant from pieces of its characteristic necklace-like or annulated roots, which he took from the established plant in August, and cut them into transverse sections, after which they were placed in a horizontal position in a prepared cutting-pot. Placed on a genial bottom-heat, covered with a bell-glass, and occasionally sprinkled with tepid water, these root-cuttings produced roots and leaf-buds in a few weeks, and the result was a batch of fresh healthy young plants, without any injury to the plant from which the pieces of

moniliform roots were taken. The plants raised were sent out to India, and arrived in excellent condition, and it is now plentiful, and may prove second only to the Cinchona in medical importance. Facts like these speak volumes in favour of skilful propagation. A new method of propagating Ipecacuanha has been devised in India by Mr Jaffray, and promises to be of great value. It simply consists in striking the leaves upright in pots. These produce roots, and the most superficial of these eventually produce buds. It is possible that this and many other rare and valuable plants might be readily imported in quantity by bringing over the roots or rhizomes in cases of moist earth. This plan of importation is worth more attention in the case of such thick-rooted plants as do not readily produce fertile seeds, or which produce seeds which only germinate when sown directly they are ripe, as in the case of the Mango and other plants.

Cinchona (Peruvian Barks).—A highly important group of Peruvian plants, of late years much cultivated at Darjeeling, on the Neilgherries, and other hill stations in India, where the extract of Peruvian Bark or Quinine is especially valuable as a febrifuge and tonic to European residents. The most valuable kinds appear to be *C. micrantha*, *C. succirubra*, *C. Calisaya*, *C. officinalis*, and their varieties *Bonplandiana*, *Uritusinga*, and many others. Cinchonas are readily propagated from cuttings of the partially-hardened young growth, or grafting such cuttings on bits of root in a genial bottom-heat is also successful. Imported seeds germinate readily in heat. In their native country (Peru), and also in the Indian Cinchona plantations, nearly all the species seed freely, and many accidental hybrids are said to have originated in cultivation where the different kinds are mixed in the same plantation. From an interesting paper in the 'Journal of the Linnæan Society,' 1870, p. 475, we learn that the Cinchonæ have long been known to produce dimorphic flowers; and this is well known to the Peruvian Spaniards, by whom the plants are named *macho* or *hembra*, according as the male or female blossoms are prominent on the branches of any single tree. This dimorphism seems to be a special provision to secure cross-fertilisation, as has been shown by Darwin and other observers in the parallel cases of *Primula*, *Oxalis*, and many other plants. In the Cinchona plantations of Madras, nearly all the most valuable kinds are grown together; they fruit freely, and numerous seedlings are raised to supply vacancies. Among these seedlings, the author of the paper above cited (J. Broughton, F.C.S.) noted a plant of great beauty which had the general habit and luxuriance

of *C. succirubra* with the lovely purple tints and velvety appearance characteristic of the "Grey Barks." On analysis, its bark —which was lighter in colour than that of *C. succirubra*—yielded 1.45 per cent of nearly pure *cinchonine*, instead of about 3.00 per cent of *alkaloid*—mainly consisting of quinine and cinchonidine, as in *C. succirubra* of the same age. This plant was picked up under a tree of *C. micrantha* as a natural seedling, while close by were trees of *C. succirubra*, which flower at the same time. Another supposed hybrid variety was found



Fruiting branch and flowers of Cinchona Calisaya.

intermediate between the last-named species and *C. officinalis*. Other varieties are appearing among the seedling trees, and these are either hybrids or cases of extreme seminal variation, some twenty of them being quite distinct from the earlier introduced kinds. Some of the Indian plantations were stocked by plants raised on the spot from imported seeds; and bearing in mind the dimorphic character of the flowers, it is possible the seeds of these might have been cross-fertilised with pollen from other allied forms in their native woods. The different species

are found to yield extracts varying in quality; and possibly systematic cross-fertilisation or grafting might be the means of improving or augmenting the valuable principles secreted by these plants.

Coffea.—The most useful and interesting plant in this genus is *C. arabica*, from the two-seeded berries of which coffee is prepared by roasting and grinding. This plant is a native of Abyssinia, whence it was long ago introduced to Arabia by the Arabs, and cultivated in Yemen; and for two centuries Arabia supplied all the coffee in commerce. About the end of the seventeenth century the Dutch succeeded in transporting it to Batavia, whence a solitary plant found its way to the Botanic Garden at Amsterdam, and in 1714 a plant was given to Louis XIV. It is a disputed point whether the French or the Dutch first introduced it to the western hemisphere. One account says the French introduced the culture of this plant into Martinique in 1717, while another historian asserts that the Dutch had previously taken it to Surinam. In either case, it is certain that we are indebted to the progeny of the solitary specimen which had been propagated from the Amsterdam garden for all the coffee now brought from Brazil and the W. Indies. This is, however, only one instance in which intelligent propagation in our botanic gardens at home has benefited the colonies to an almost incredible extent. Kew has been the intermediate resting-place for most of the Cinchona plants introduced by that indefatigable traveller, Mr R. Cross, from Peru to India; while in the Edinburgh Botanic Garden the Ipecacuanha plant (*Cephaelis*) has been increased for export to India in a very intelligent manner; and at the time I write, Mr Bull has a fine batch of seedlings of Liberian coffee, which has a larger berry, and is said to be otherwise superior to the ordinary kind. Coffee is readily propagated by sowing the seeds or berries in a genial bottom-heat of 70°-80°. Cuttings will root in a close case, but not so quickly as if grafted on thick bits of root well furnished with fibres at the lower end. Wherever this shrub is largely grown, seed is the method generally adopted.

Gardenia (Cape Jasmine).—A favourite genus of West Indian and African flowering stove-shrubs, represented in our gardens by *G. radicans*, *G. florida*, *G. intermedia*, *G. Stanleyana*, *G. citriodora*, and one or two others, the double-flowered forms of *G. radicans* and *G. florida* being most generally grown for the sake of their pure-white deliciously-perfumed flowers. All the species are readily propagated by cuttings of the ripened wood, or by herbaceous cuttings in

spring. Seed may be obtained from well-grown plants of the single-flowered kinds, but cross-fertilisation is necessary. Imported seeds may be sown in light sandy soil in a bottom-heat of 70° to 80°; but if the object is merely to reproduce the plants, then cuttings are in every way preferable. Small flowering-plants of *G. radicans*, *G. florida*, or *G. Fortunei* may easily be obtained by taking off the branches of a large plant after the flower-buds are set, and striking them separately in small pots, in the gentle bottom-heat of a close propagating case. Every branch will root readily in a week or two, and they may then be removed to a warm stove, and placed near the light to open their flowers.

Ixora.—A showy genus of stove-shrubs, principally E. Indian, readily propagated by cuttings of the young wood inserted in sandy soil, and plunged in a bottom-heat of 70° to 80°. Seeds may be obtained from nearly all the species by fertilising the flowers, although not unfrequently seeds are produced without artificial assistance. Mr Fraser of Lea Bridge has raised some very beautiful orange-flowered varieties from seed, *I. Fraseri* (1874) being one of the best. Messrs Cole & Son, Withington, Cheshire, also raised a fine pure white-flowered hybrid (*I. alba* × *I. coccinea*) a few years ago, which was distributed in English gardens under the name of *I. Colei* (1870). There seems every reason to believe that this genus will be much improved, as seedling plants vary much in habit and colour. *I. Williamsii*, *I. amabilis* (*I. floribunda-nana*), and *I. Prince of Orange*, are also seminal varieties, raised about 1873-74 by Mr Fraser. In speaking of these new varieties, the 'Florist' says: "It is something new to treat the Ixora as an annual. Nevertheless, Mr Fraser gets seedlings to bloom freely at about one year old, the plants yielding many new tints of colour, no two coming exactly alike. This method of growing dwarf, bushy, free-flowering examples of the Ixora, is worthy of adoption in establishments where plants of this kind are in demand for decorative or for market purposes." *Ixora coccinea* was introduced in 1690, but having been lost it was again propagated from imported seeds in 1775 (see 'Bot. Mag.,' t. 169). Ixoras may be grafted in a warm humid case with facility, either by whip, splice, or veneer grafting, and this plan is very useful in renovating exhibition specimens.

Rogeria.—A small group of herbaceous plants or shrubs, represented in our gardens by *Rogeria gratissima* and one or two other less well known species, principally natives of the African continent. *Rogeria* may be propagated either by

seeds or by cuttings of the young growth in heat. *R. hybrida* is a garden hybrid obtained in Belgian gardens, sent out by Mr W. Bull, and useful for the sake of its pink fragrant flowers. Parents not precisely known.

THE SPIDER-WORT FAMILY (*Commelynaceæ*).

A small family of erect or scandent and mostly evergreen tropical herbs, represented in our gardens by various species of *Tradescantia*, *Commelyna*, *Cyanotis* and *Dichorisandra*. The hermaphrodite, triquetrous flowers are commonly white, blue, or purple in colour, and are generally distinguishable by the beautiful silky hairs which clothe the filaments. They are chiefly natives of the East and West Indies, New Holland, and Africa, a few occurring in North America, but none in Europe or North Asia. They are readily multiplied by seeds whenever obtainable, and these should be sown as soon as ripe on pans of well-pressed light sandy compost, after which cover with a green pane of glass or a sheet of brown paper, and place on a gentle bottom-heat to germinate. Division is practicable in the case of Tradescantias and Dichorisandras, while cuttings of the young and partially-hardened growth root freely in a close case. The hardy Spider-worts are readily multiplied by careful division.

THE ASTER FAMILY (*Compositæ*).

The largest of all the great orders into which botanists divide plants, nearly 9000 species being known, and these are distributed over nearly the whole surface of the earth. It is interesting to observe the curious structure and growth of the bilobed style in nearly all Composites. If the disc-florets of a single Dahlia (see fig. p. 254) or a Daisy be examined, it will be seen that the five anthers are syngenesious—that is, joined together at their margins in such a manner as to form a short tube; and owing to the slower or later development of the style, it is concealed below these anthers until they are ready to discharge their pollen, and just at this time it commences its upward growth through the tubes formed by the anthers, its two lobes being firmly adpressed so as to prevent any pollen lodging on their inner faces (stigmatic surface). The top of the style thus presents a knobbed or club-shaped appearance, and is set with stiff, sub-erect, short hairs or bristles, the

apparent use of which is to brush the pollen from the introrse anther-cells, and to carry it upwards out of the flower-tube, after which it is blown by the wind or carried by insects on to the receptive stigmas of the older outer flowers of the same disc, while the stigmas which have thus assisted their older brethren are themselves fertilised in like manner by the development of the inner flowers. A close examination of a Daisy or Sun-flower, or any other single-flowered Composite, will show the process going on in all its stages. Some plants which bear their flowers in spikes also develop the sexual organs in each flower unequally, the anthers shedding their pollen before their attendant stigma is receptive, so that it is left to be fertilised by the pollen which falls or is carried by insects from flowers higher up the spike (see Agave). Many Composites are naturally hybridised, as is shown in the genus *Carduus;* and in gardens we have hybrid races of *Zinnias*, while the cross-bred and seminal forms of *Dahlia*, *Chrysanthemum*, and *Aster* are innumerable. Here again we see that the flowers of Composites, although hermaphrodite and arranged contiguously, are practically monœcious; and wherever this is the case with hermaphrodites, as a rule we find hybridism to be comparatively easy. This order affords many ornamental plants, especially annual and herbaceous Asters, Chrysanthemums, Zinnias, Marigolds, &c.; while from a culinary point of view the order is interesting, as affording such plants as Artichokes, Lettuce, Salsify, Scorzonera, Skirrets, Endive, Succory, and other vegetables. Many species are used medicinally, as the common Chamomile; and some few are acrid or poisonous. Perhaps no order is more productive of perfect seeds than this, if we except *Gramineæ* (grasses and cereals), and this has doubtless enabled them to increase and multiply to the present enormous extent. There is scarcely a single species which cannot be readily increased by seeds sown either as soon as ripe or in the spring. Those which do not seed or rather flower freely, may be propagated by cuttings or division. The woolly-leaved Composites are best and most readily multiplied from seeds: if cuttings have to be resorted to, however, insert them in a dry medium, and place them on an airy shelf fully exposed to the sun, as they are apt to damp off, as is well known to be the case with the silvery-leaved Centaureas of the *C.* (*ragusina*) *candidissima* group. The same remark applies to the fleshy-leaved or succulent species, such as *Kleinia*, *Othonna*, *Mikania*, *Senecio*, *Mesembryanthemum*, and others. One of the most beautiful Composite plants we have seen for the purpose of table decora-

tion is a hybrid Sonchus, raised between *Sonchus laciniatus* and *S. gummifer*, in the garden of W. Wilson Saunders, Esq. These Sonchuses, grown to a single stem, and furnished down to the pot with their elegantly cut drooping leaves, which are almost transparent under artificial light, form admirable objects for the purpose above mentioned.

Ageratum.—A genus of South American Composites, the best known species being *A. mexicanum*, which has been extensively employed as a pale-blue or lavender-coloured bedding plant. Cuttings of the young shoots strike freely in heat, either in spring or autumn. Seed is frequently produced, especially on pot-plants grown indoors, and it germinates readily treated like *Cineraria*. Several dwarf-growing varieties have been obtained from seeds or sports.

Asters.—A large genus of herbaceous plants, popularly known as "Michaelmas Daisies," and very ornamental during the late autumn months. The most showy kinds are *A. novæ-angliæ*, and its rosy and purple flowered varieties, *A. cassiarabicus*, *A. turbinellus*, and *A. versicolor*. There are few late-flowering hardy plants which would repay a little extra trouble and attention on the part of the hybridiser better than these. One of the best of all the late-flowering species is the white and lilac flowered *A. versicolor*—a fresh small plant, little over a foot in height, and yet as showy in its way as the large-growing kinds, some of which attain a height of from six to eight feet in deep rich soils. To obtain ripe seed from the very late kinds, it would be necessary to pot them, and remove them to a dry sunny greenhouse; and as a compact-habited seed-bearing parent, *A. versicolor* would undoubtedly be the best dwarf kind. This might be crossed reciprocally with *A. novæ-angliæ*, and its varieties *pulchellus* or *roseus* or *A. turbinellus*; and the result, if we mistake not, would be a hybrid race far better and more ornamental than nine-tenths of the species or forms now grown. Indeed it is questionable whether this plant would not rival the Chrysanthemum in a few years as a pot-plant for winter-flowering, if cross-breeding were intelligently carried out. Even seeds, collected from the best forms, might produce many improved varieties, for these flowers are much visited during sunny weather by bees, flies, and other insects, and doubtless cross-fecundation is, through these, accidentally effected. At any rate, here is an open field for some intelligent cross-breeder to try experiments, which may be easily conducted, even by a beginner.

Two or three hundred kinds from North America, China, and North India are named in books as species, but most of these

are merely natural seminal varieties. They all seed freely, and are readily propagated by cuttings of the young growth during the summer months, inserted in pans and placed in a close frame, or pricked into a thin layer of sand on a north border and covered with a hand-light. The China Aster is *A.* (*Callistemma*) *hortensis*, and is readily multiplied from spring-sown seeds in heat, planting out after all danger from frost is past. There are two distinct strains or races; the "French," in which ray florets only are developed — and the "German," or "Quilled," in which the florets of the disc form a rounded, cushion-like mass. The late Mr Betteridge, a well-known florist, improved the "Quilled" varieties considerably.

Chrysanthemum. — A well-known and beautiful genus of decorative plants, introduced to this country from China, where they have long been cultivated, as also in Japan, whence Mr Fortune introduced the long-quilled Japanese varieties now so popular. Two species—*C. leucanthemum*, the "Ox-eye Daisy" of our meadows, and *C. segetum*, or "Corn Marigold"—are common weeds in this country. The Chrysanthemum, *C. indicum* (or *Pyrethrum sinense* of some botanists), was much improved by the late Mr Salter of the Versailles Nursery, Hammersmith, as also by Mr Forsyth of Stoke Newington, and other cultivators. There are three or four sections, as "Large-flowered," "Small-flowered," "Anemone-flowered," and "Japanese." Several other species have been introduced, as *C. grandiflorum* from the Canaries, *C. pinnatifidum* from Madeira, *C. fruticosum*, with elegantly-cut glaucous foliage and white daisy-like flowers, and others; and it is a little singular that hybridisers should never have effected a cross between some of these and the Chinese or Indian species. The original form of *C. indicum* does not appear to be grown in our gardens; but the Chinese and Japanese have doubtless grown and improved its varieties for ages before we obtained some of their garden forms. Naturally the Chrysanthemum has a leggy habit, and is apt to become bare at the bottom; and although we can overcome these drawbacks by a systematic course of good culture, it is none the less desirable that a cross should be effected between this and some better-habited plant. Cuttings taken off in spring strike readily in a close frame, or even in the open air in May, if inserted on a shady border and covered with a hand-glass. Chinese gardeners graft some Chrysanthemums on a species of Artemisia as a stock; and, so treated, they are said to grow more vigorously and flower better than on their own roots. It would be interesting to know the exact species of Artemisia employed; but doubtless some of the strong-

growing species known to us would answer equally well. Seeds, as in the case of Dahlias, should be saved from plants from which the flowers have been thinned. A dry sunny plant-house is best in which to grow the seed-bearing plants, as of all flowers this is most apt to suffer from dampness in the atmosphere.

Seeds should be sown in February in pans of light earth, covered with a pane or bell-glass, and placed in a genial heat of about 65°. Like most other Composite seeds, they germinate readily, and should then be placed on a shelf near the light. Prick off into pans an inch or more apart, as soon as they can be handled; and if afterwards potted in well-manured sandy loam, and placed in the open air in June, they will flower the first year.

Cineraria.—A genus of winter and spring blooming decorative plants, which have long been popular in our gardens.

Hybrid Cinerarias

Cineraria cruenta (see 'Bot. Mag.,' t. 406) was introduced from the Canaries in 1777, and from this plant we may date our greenhouse Cinerarias, it having been the parent together with

C. aurita, an old slender-habited plant like a purple Groundsel (see 'Bot. Mag.,' t. 1786). *C. lanata* is a large-flowered rosy species from Africa (see 'Bot. Mag.,' t. 53), and is doubtless one of the parents of our present cross-bred races. Cinerarias are readily propagated by seeds, which germinate very freely, and self-sown seedlings often appear abundantly on the pot-tops. Seedlings of excellent quality may be perpetuated from offsets. Several species of *Cineraria* have yellow flowers; and a race of golden-blossomed hybrids of neat habit would be invaluable for contrasting with the purple, rosy, blue, or white kinds.

Double-flowered Cinerarias were introduced to our gardens from Germany in 1874, and Mr Moore thus alludes to them in the 'Florist:' "Double-flowered Cinerarias are not absolute novelties, for we remember having seen exhibited in London, in 1861, by Mr Kendall of Stoke Newington, a variety called *C. rosea plena*, to which a commendation was then awarded, and which was a very pretty, compact-growing, double flowered variety, with the flower-heads of a magenta rose. Whether that was lost or not, or did not perpetuate itself, we do not know, but it was not seen again in public; nor has a double-flowered Cineraria appeared since that time, so far as we are aware, till this year (1874)."

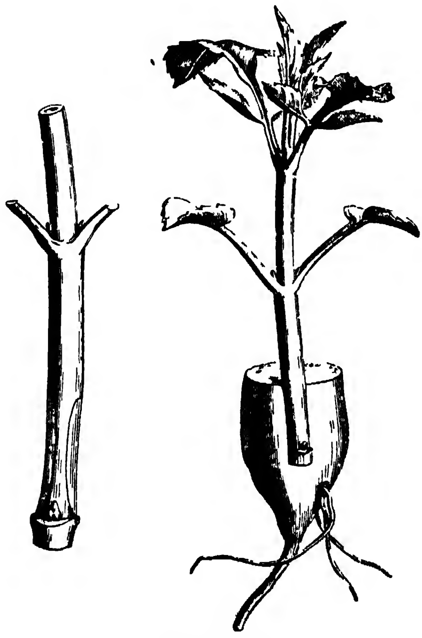
Dahlia (*Georgina*).—A well-known genus represented in our gardens by the varieties of two Mexican species—*D. frustranea* and *D. superflua*.

A correspondent of the 'Garden' (1874) gives the following interesting history of the Dahlia: "The first mention of the plants occurs in Hernandez, who published a history of Mexico in 1651, and who figured two separate species. Menonville, who was employed by the French minister to steal the cochineal insect from the Spaniards, was the second to notice its existence. The first scientific description was given by the Abbé Cavanilles from a specimen which flowered at Madrid in 1790, who named the plant after his friend Andrew Dahl, the Swedish botanist. The Dahlia was sent to Europe from the Botanic Gardens of Mexico to the Royal Gardens, Madrid, where it first flowered in 1789, from whence it was introduced to England by the Marchioness of Bute in the same year; but this single plant speedily perished, and it did not again appear in this country till the old single variety *coccinea* was flowered by Fraser, at Chelsea, in 1803, and figured in Curtis's 'Botanical Magazine,' plate 762. This plant also perished. Meantime Cavanilles sent specimens of the three varieties then known to the Jardin des Plantes, in 1802, where they were successfully cultivated; and numerous varieties were produced in France

between that date and 1814, when, on the return of peace, the improved flower created a great sensation among English visitors to Paris, which led to large importations of the root during the ensuing winter. Lady Holland sent seeds, not roots, from Madrid in May 1804. The first plant flowered at Holland House in September following, and was figured in Andrews's 'Botany.' The seeds ripened in 1805, and were generally distributed in 1806. The original plants at Madrid do not appear to have yielded many varieties—not more than three are mentioned. Humboldt, however, who found the plant growing in sandy meadows 5000 feet above the sea, sent home fresh seed from Mexico in 1804 to Paris and Berlin, from which the numerous varieties subsequently obtained were derived. The first double flower was produced at Berlin in 1809; and even so late as 1818 Sabine was told of a double white, but 'doubted its existence.' It is interesting to remark that De Candolle expressed his opinion that we should never see a blue Dahlia, on the ground that blue and yellow, being the fundamental types of colour in flowers, mutually exclude each other."

There is a race of very pretty little small-flowered or Pompon varieties, and some of the small single-flowered scarlet varieties are very beautiful. *D. imperialis* (see 'Bot. Mag.,' t. 5813), a large tall-growing species, was introduced to this country about 1867-68, and first bloomed in the Royal Horticultural Society's Gardens at Chiswick in 1869-70. Nearly all the species and varieties are tuberous-rooted, and are readily propagated by herbaceous cuttings, division, or by herbaceous grafting on tubers of common kinds. Old tubers placed in a genial bottom-heat in spring yield plenty of cuttings, which, when taken off with a heel in February or March, when 4 or 5 inches in length, root freely. They may be potted in any light compost, and should be plunged in a bottom-heat of 75° or 80°. When well rooted they should be hardened off preparatory to planting out after all danger from frost is over. Grafting is useful where it is desirable to give seedlings or delicate varieties a good start by working them on a rooted piece of the tuber of some common variety. A slice of the fleshy bark is taken off each side of the cutting-like scion or graft, and a corresponding slit or cleft having been made in the stock, the two are fitted together as shown in the illustration on next page; and, after being firmly bound, the two are potted in warm soil, and plunged in a gentle bottom-heat, until a union is effected. The lower point or heel of the scion is left exposed, and not unfrequently emits roots itself, after a union with the stock has been effected. *D. imperialis* was grafted by the late Mr

Salter on some of the small-growing varieties; and this stock had a dwarfing effect, the plants so treated having flowered in a much smaller state than others grown on their own roots. New varieties are only to be obtained from seeds saved from good sorts. The following is Mr Keynes's advice, as given in the 'Gardeners' Chronicle,' October 16, 1875, p. 495: "Towards the end of summer, when the raisers of seedling Dahlias are turning their attention to the harvesting of seed, it is well to recall a caution given some years ago, 'that



Dahlia Grafting.

'so surely as the grower leaves many blooms on a plant, so surely will those blooms fail to produce seed.' The invariable rule is to cut the plants pretty much to pieces about the middle of September by freely thinning them out, for by this date the Dahlia shows are over. Only the buds that are coming into flower are left, and as an invariable rule these yield seed in abundance. It would appear that the earlier blooms of the Dahlia do not as a rule produce seed, and the moment (so states Mr Keynes) a plant begins to seed, its flowers cease to

be so perfect. Fine blooms and the production of seed cannot go together. The stoppage of growth in the plants by keeping them thinned out is said to largely determine the production of seed. At the middle of October, or when the season is so far advanced as to risk any danger from the frost, the seed-pods are cut away with a stem some 6 or 8 inches long, and the practice is to tie them up in bundles, a half-a-dozen or so together, and hang them up in a dry loft or greenhouse, and use fire to finally dry the pods, should the weather be continuously damp and wet.* As soon as dry enough, the seeds are rubbed roughly out of the pod, put into paper bags, and hung up in a dry place, and cleaned at leisure for sowing in early spring."

Sow the seeds in February in well-drained pots or pans of rich sandy earth in heat, and prick them off into pots when sufficiently large. After all danger from spring frosts is over, plant the young seedlings out in beds of light rich earth, where they will grow rapidly, and flower the first or second year. Select the best flowers, and throw away the bad ones, or keep the tubers for stocks on which to graft new kinds in the spring.

Dahlia (*Georgina*) *coccinea* (see 'Bot. Mag.,' t. 762; see also t. 1885, a and b) appears to have been one of the first of the cultivated kinds, and bears single flowers of a bright scarlet colour, the disc-florets being golden yellow. This is now in cultivation as a showy border plant, and is supposed to be the original kind whence our improved florists' varieties were obtained; but there are scarcely any modern forms that at all approach it in brilliancy of colour, if we except "Charles Backhouse." It flowers late in the autumn, seeds freely, produces a copious supply of potent pollen, and ought to be invaluable to the hybridiser in improving the colour of existing varieties. It is questionable whether this is a genuine species, for I find the florets of the ray very irregularly developed, some being quite sterile owing to the suppresssion of the stigmas, while in some flowers I find the stigmas partly normal and partly petaloid. Hybrids between this brilliant old plant and *D. imperialis*, a tall-growing species, with snowy, long-petalled, bell-shaped flowers, ought to give a most gorgeous race of varieties quite distinct from those now in cultivation, and far more elegant in form and brilliant in colour, especially for conservatory decoration during winter, or for culture in the open air. Attention

* The stems may be cut on the approach of frost, and placed in bottles of water in a warm, dry, and sunny vinery, where the seeds will ripen better than if left in the open air; or, perhaps, flowering shoots when in bud might be rooted by circumvallation, or as cuttings, and removed to a dry sunny house to flower and ripen their seeds.

Dahlia coccinea

ought to be paid to the Dahlia as an indoor plant, for which it would rival the Chrysanthemum, and its colours are much brighter. In the open air in our climate the Dahlia is cut down by the frost just as it attains its full perfection; but by striking cuttings, or grafting late in the season, we might obtain dwarf plants in pots for winter blooming in a sunny greenhouse, either for decorative, hybridising, or seed-saving purposes.

A new species (*D. gracilis*), discovered in Mexico by M. Roezl in 1873, deserves the attention of the intelligent hybridiser. It appears that the brilliant single flowers are similar to those of *D. coccinea;* but the whole plant is much more elegant in habit, and has finely-cut foliage like *Cosmos bipinnatus*, not simply pinnate as in *D. coccinea*. It is to be sent out this year (1876) by M. Lemoine of Nancy. *D. Decaisneana* is another elegant species similar in habit to *D. coccinea;* but the ray flowers are deep lilac-purple, with a yellow disc.

To show the estimation in which new Dahlias of superior quality were held thirty years ago, we may remark that for the entire stock of a large-flowered, dark-shaded red variety raised by C. Sainsbury, Esq. of Swainswick, near Bath, Messrs W. G. Drummond of the same place paid the raiser 100 guineas. This variety was named "Beeswing," and was sent out in 1845 at half a guinea per plant.

Lactuca.—A genus represented in our gardens by the numerous forms of Lettuce produced by culture, seminal variation, and selection. In 1874, M. Naudin obtained a hybrid between *Lactuca virosa* and the cultivated variety of *L. sativa* known as the "Dutch Cos."

"The hybrid of the first generation was fertile, and from its seeds issued a progeny exceedingly variable, but in which the characteristics of the two species were mixed in varying degrees. Twenty of these were reserved for future study. Of these twenty no two were alike. At the same time, while there was so much variation, so strange an intermixture of the characters of both parents, there was no new character produced—nothing which might not be met with in one or other of its parents. The variation, great as it was, was confined within limits which were never overstepped. If we may be permitted the comparison, M. Naudin's protean Lettuces were like the coloured fragments in a kaleidoscope—never twice alike, although always consisting of the same elements."—See 'Gardeners' Chronicle,' 1875, p. 748.

Senecio (*Groundsels*).—A genus of free-growing annual or perennial plants, principally natives of temperate countries, and represented in our gardens by several species. *S. elegans* (see

'Bot. Mag.,' t. 238) is one of the oldest exotic species, and was introduced to our gardens about the year 1700, and its double-flowered variety is still occasionally grown as a flower-garden plant. It is a native of the Cape, and may be propagated from cuttings, or occasionally from seeds which are produced by semi-double-flowered individuals. *S. mikanoides*, or "German Ivy," is a fresh, green-leaved, scandent species, also from the Cape, and it is much used in North Europe and in America as a room or window ornament. *S. macroglossus* is also a Cape species, with glossy ivy-like foliage, and large eight-rayed pale-yellow flowers fully two inches in diameter (see 'Bot. Mag.,' t. 6149). By far the noblest species in cultivation, however, is *Senecio pulcher* (see 'Bot. Mag.,' t. 5959), which grows from two to four feet in height, bearing large purple-rayed flowers nearly three inches in diameter, each having a clear yellow disc. The intelligent hybridiser will do well to keep his attention fixed on this noble Composite, as seminal variation and superior culture may be potent enough to originate new forms of it, especially if aided by cross-fertilisation or hybridism. It is a half-hardy species from South Brazil, and flowers late in the autumn, just before the frosts. Grown in pots in a warm sunny greenhouse or conservatory, its flowers rival in size and brilliancy those of the Chrysanthemum. Root-cuttings grow freely.

Tragopogon (*Salsify*).—A well-known genus of Composites, principally natives of Europe and the temperate parts of Asia. *T. porrifolius* is the common Salsify, a biennial, native of England and Europe. Readily propagated from seeds, this crop requires two years to complete its growth. Linnæus obtained a hybrid (*T. hybridum*) between *T. pratense* and *T. porrifolius* in 1759. He fertilised the flowers of *T. pratense* with his own hand (after having emasculated its own flowers) with the pollen of *T. porrifolius;* and from the seeds which resulted from this cross, *T. hybridum* was raised—this plant being intermediate, and bearing purple flowers, the florets being yellow at the base.

Zinnia.—A showy genus of Mexican annuals, represented in our gardens by numerous forms of *Z. elegans*, and more recently by a hybrid race between *Z. elegans* and *Z. Ghiesbreghtii*, a yellow-flowered plant known in gardens under the names of *Z. Haageana*, *Z. aurea*, or *Z. mexicana*. All are readily propagated by seeds sown in heat in March, or in the open air in May. These plants have been much improved in French and German gardens. M. Léon Lille, Cours-Mourand à Lyon, hybridised *Z. Ghiesbreghtii* with pollen of *Z. elegans* in 1864, and the twenty or thirty fertile seeds obtained by this union produced about twenty plants, only one of which was remark-

able. This was vigorous, of good habit, and bore a profusion of rich orange flowers, the ray florets tipped with scarlet. In habit and foliage this hybrid resembled the female parent, and the influence of the male parent was shown by the size and colour of the flowers. During the summer and autumn this new seedling flowered freely; but only a few fertile seeds were obtainable, and these, sown in 1867, produced seventeen plants, all distinct from each other—some, however, resembling the male, and others the female parent. Four of these were very distinct, and more beautiful in form and colour than either parent, and these were selected as seed-bearers; and in 1868 a numerous progeny was obtained, and ten or twelve of the best are far superior to anything seen in this genus before, the flowers being large, finely shaped, and of variable and very beautiful colours.

In 1875 Messrs Haage & Schmidt, the celebrated seed-growers of Erfurt, Prussia, sent out a new double hybrid Zinnia obtained by crossing the above-named species. This new hybrid is named *Z. Darwinii*, and four of the most distinct forms have been selected for distribution—viz., *Z. Darwinii major*, bearing large, double, self-coloured flowers, two inches across; *Z. Darwinii vittata*, bearing striped flowers; *Z. Darwinii*, bearing double cone-shaped flowers; and *Z. pyramidalis vittata*. In colour the flowers of all these varieties vary much, the principal shades being orange, yellow, scarlet, crimson, rosy-purple, white, yellow with white, purple, or crimson flakes, &c. This race is quite distinct from the numerous beautiful seminal forms of *Z. elegans* (see 'Gard. Chron.,' 1875, p. 782).

THE PINE AND FIR FAMILY (*Coniferæ*).

This is an important family of evergreen or deciduous trees, represented in northern or temperate countries by *Abies* (Firs), *Pinus* (Pines), *Cedrus* (Cedars), *Juniperus* (Junipers), *Taxus* (Yews), and others; while in Australasia and South America these hardy kinds are replaced by *Araucaria*, *Eutassa*, *Dammara*, *Dacrydium*, and *Podocarpus*. From an economic point of view many species are valuable as furnishing timber, resin, oil, pitch, and turpentine; while as ornamental trees or shrubs they add considerable beauty to our garden landscapes. The fibres of coniferous woods are curiously pitted, and form interesting microscopic objects. Among the finest ornamental kinds found in gardens, we may name *Abies*

Douglasii, *A. pinsapo*, *A. nobilis*, *Araucaria excelsa*, *A. imbricata*, *Cedrus deodara*, *C. atlantica*, *C. libani*, *Pinus picea*, *P. pinaster*, *P. longifolia*, and many others; *Taxodium sempervirens*, *T. distichum*, *Wellingtonia gigantea*, *Salisburia adiantifolia*, and very many others, all more or less beautiful. Conifers are readily multiplied by cuttings, layers, or seeds; while the golden or variegated forms of Taxus, Cupressus, Thujopsis, &c., are generally reproduced by grafting on stocks of their respective green-leaved or normal kinds: Seedlings form the best stocks, but where they are not handy, cuttings may be substituted. The common Larch (*Larix europæa*) forms a good stock for the Deodara and Cedar, as also does *Cedrus atlantica*.

Every one who raises Conifers from either home-grown or imported seeds is well aware of the diversity of colour and habit which the seedling plants assume. This is particularly observable in Lawson's Cypress; but Abies, Wellingtonias, Araucarias, and Piceas show the variation in a scarcely less marked degree; and many of the most beautiful forms of Yew, Abies, Cupressus, and Thuja have been originally either natural variations selected from the seed-bed, or sports perpetuated by grafting the variegated branches on a plant of the green or normal form of the species as a stock. Up to the present time, I believe I am right in saying that we have no hybrid Conifers—that is, no garden hybrids raised by artificial fertilisation; for there can be but little doubt that Conifers, being mostly gregarious and furnished with such ample supplies of easily-wafted pollen, are often cross-fertilised or even hybridised in a state of nature: and another point in favour of this cross-fertilising process having long taken place is, that imported seeds produce such a diversity of offspring. There appears to be no valid reason why we should not raise hybrid Coniferæ in our gardens, now that we have so many fertile or cone-bearing specimens of the rarer and more beautiful kinds; and I strongly urge those who have the opportunity, to make experiments in this direction. By crossing the more beautiful and tender kinds with hardier species, we might obtain hardier races; and if of additional beauty of leafage or habit, so much the better. Again, some rare Conifers produce ample supplies of pollen before they bear fertile cones, and by using this pollen to fertilise older cone-bearing trees belonging to the same or an allied genus, good results might be obtained. No matter, however, whether success or failure is the result, the careful artificial fecundation and cross-fertilisation or hybridisation of Conifers is well worth attention from cultivators, as it appears to be as yet an untrodden path to horticulturists.

The fertilisation of *Taxus* and *Cupressus* is very interesting. It appears that a drop of clear mucilage is exuded from the orifice at the top of the ovule or young seed of these plants. The pollen-grains fall on to this mucilage, which retains them, and both mucilage and pollen-tubes are absorbed into the interior of the ovule. According to M. A. de Candolle, Vaucher long since pointed out this fact; and his 'Histoire Physiologique des Plantes d'Europe' contains much valuable information of peculiar interest to the intelligent propagator and hybridiser.

The Red Cedar (*Juniperus virginiana*) has several times been observed to have fertilised the female organs of the American Arborvitæ (*Thuja occidentalis*), the issue from which is that curious whipcord-branched plant called in gardens *Thuja filiformis*. This hybrid was produced for the first time accidentally in Messrs Loddige's nursery at Hackney, and has since been raised in a similar manner in French gardens (see 'Gard. Chron.,' 1844, p. 587).

H●bert remarks: "There is every reason to believe that Thuja and Cupressus have bred together; and those who look to the small difference between them will become satisfied that they form two sections of one genus." Retinosporas come mostly from Japan; but one or two of them, or what pass for such, are known to have originated from seed of the American Arborvitæ. M. Carrière, in the 'Revue Horticole,' after a long study of them, comes to the conclusion that all the species of Retinospora fall into two series, and have been derived—one set from the American Arborvitæ, the other from the Chinese or Japanese Arborvitæ (*Biota orientalis*).

The Fir-trees belong to a well-known family of graceful-habited Conifers, very valuable in ornamental or landscape gardening, and useful as timber-trees, and as the source of turpentine in all its forms. All the kinds of *Abies* are best propagated by means of seed. The fully-matured cones should be gathered during the winter season, and exposed either to sun-heat or to the gentle warmth of an oven or kiln—this treatment being requisite in order to readily separate the seeds from the cones. The Firs give out their seeds very easily and quickly—much more readily than the Cluster and Stone Pines, which require the gentle application of heat for several weeks, or even months, ere their seeds can be separated from the close-scaled cones. The method of extracting the seeds from Cedar and other Conifer cones by splitting is tedious, and often injurious to the seeds. M. Delépine, of Angers, states that the plan he adopts is much simpler and better. About February the cones are buried at a

depth of two feet underground in sand; they remain thus for a month or two, after which the cones scale easily without force, and the seeds are then picked out and sown immediately, and being swelled, they germinate at once. In the case of all Coniferæ, seeds undoubtedly afford the best mode of reproduction whenever they can be obtained; but in the case of rare and new varieties, grafting and cuttings have perforce to be resorted to as auxiliary, and in some cases the quicker modes. The cones of Cedars are very resinous when newly gathered, and ought to be left a year before the seeds are separated, much of the resin having during that period passed away by evaporation. The following experiments on the germination of Conifer seeds were made by Mr J. Alexander, and are recorded in the 'Transactions of the Scottish Arboricultural Society:' "In the year 1870, twenty cones were gathered from each of ten different trees, whose ages were approximately ascertained by counting the concentric circles in other trees felled beside them. The cones were carefully opened, and all the seeds of the ten different sorts sown in separate beds, when the following was the result:—

"The seeds of twenty cones from a tree

300	years old	produced	10	plants.	100	years old	produced	196	plants.
250	"	"	13	"	50	"	"	104	"
200	"	"	59	"	15	"	"	46	"
150	"	"	74	"	10	"	"	40	"
125	"	"	106	"					

It thus appears from these observations that cones should only be gathered from trees over 50 and under 125 years old."

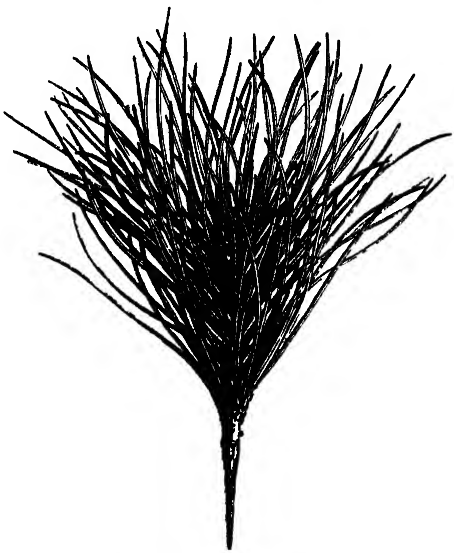
The same experiment was again tried in 1871 with other trees, when the result was much the same as in 1870.

In a paper on "Gathering the Cones of Resinous Trees," printed in the 'Gardeners' Chronicle,' 1872, p. 1557, Mr Ellison maintains by illustrative examples that the premature gathering of the seed tends to weakness in the plants. Foreign seed, he remarks, from the native forests, is invaluable when imported in fresh-gathered cones, secured from the trees at the conclusion of the alpine winter; but is not worth having if they have been gathered prematurely. Curiously enough, other seeds have been found to be much improved if left on the plants all winter; and this is notably the case with stock-seed.

The latter end of March, if mild, or the beginning of April, is the best time to sow all Conifer seeds; and it is an excellent plan to place the seeds in a bag and soak the bag in water, for a day or two, taking care to dry the seeds in the sun before

sowing. The rarer sorts are generally sown in pots, pans, or boxes of rich moist earth; and the protection of a pit or frame is given them until they have advanced in growth sufficient to be pricked out in lines in the nursery-beds. The more common and hardier kinds are, however, sown at once in nursery or seed beds a yard or 4 feet in width. The richer and more friable the soil the better; and the depth at which the drills should be drawn must be regulated by the size of the seeds, say from half an inch to 1 inch, which in the case of the larger and stronger kinds will be amply sufficient. If these seed-beds are sheltered by hedges of Yew, Juniper, Privet, or Beech, so much the better. The seedlings may be lifted about a year after they are sown, or in the April following, and pricked out in lines 6 or 8 inches apart, leaving a space of about an inch between each seedling plant; and plants so treated will be found to have made considerably more progress than those left thickly in the seed-beds for two years, an old-fashioned plan still largely practised. As a rule, seedling Conifers should be lifted every year they are in the seed-beds, or until they are either sold or planted out in permanent positions in the woods or pleasure-grounds. If seeds are not obtainable, the next best mode of propagating Conifers generally is by cuttings, which should be selected from the side shoots when the sap is in full motion. They should consist of last year's growth branchlets, say 4 to 6 inches in length, with a heel of the old wood, which causes them to root better. *Retinospora*, *Taxus*, *Thujas*, *Thujopsis*, *Wellingtonia*, *Cedrus*, *Cephalotaxus*, *Cryptomeria*, *Dacrydium*, *Podocarpus*, *Cypress*, *Libocedrus*, *Torreya*, and many other well-known Conifers, are readily multiplied by cuttings like those already described. The usual practice is to insert the cuttings or slips in pots, pans, or boxes of light sandy compost, and place them in a cool and shady frame at the back of a north wall or with a northern aspect. The more tender species and varieties, however, strike quicker and with more certainty if pricked into pots of small crocks having about an inch of sandy soil at the top. These, if placed in a genial heat of 75° to 80°, will have emitted clusters of white fibrous roots in about a fortnight or three weeks; but they must be carefully hardened off and potted singly, after which they may be placed in a cold frame and finally planted out in the ordinary way. Seed is undoubtedly the best method of propagating all Conifers when it is obtainable; and cuttings are better, as a rule, than grafted specimens, as the latter often throw out lateral leaders instead of terminal or erect ones, and these spoil the symmetry of the

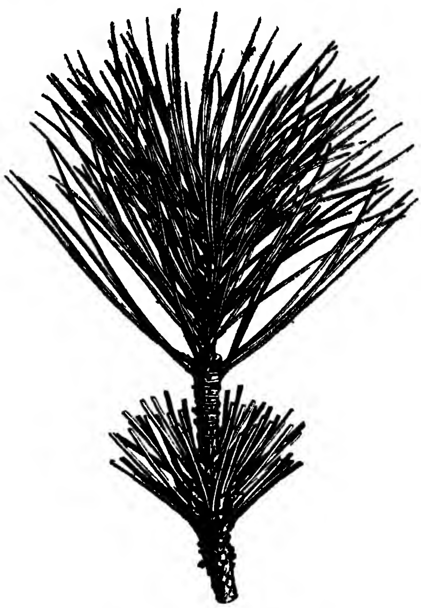
specimen. Where the central leaders of Conifers do not start away freely, the lateral branches, especially those which grow faster than their neighbours, should be shortened in about October. This throws fresh vigour into the leader and preserves the symmetry of the tree. Many propagators who bud Roses or graft fruit-trees with every success, flinch at operating on Conifers, and this without any apparent reason except that the plants are a little different in appearance; and this mode of propagation is but rarely resorted to except in trade collections. All Conifers, if not too resinous, may be grafted as easily as a Plum or a Pear. Scions or grafts are



Conifer Graft (Pinus) prepared

selected from the last summer's growth, and are grafted on stocks of the same or nearly allied species all through the winter months in a genial heat, the stocks being seedlings or cuttings grown in small pots for the purpose. Terminal grafting is practised in the spring, taking the scions from the tips of the main branches when in a herbaceous state. The scions may be 1½ to 2 inches in length, and should be inserted on the apex of a seedling or rooted cutting of an allied hardier or less valuable species as a stock. This operation is best performed in a heated close case; or if in the open beds,

cloches must be used. If in the open air, however, the operation must be deferred until the sap commences to move in the spring. Nearly all the species and varieties of *Picea* and *Pinus* are best propagated from grafts when seeds are not to be had. The Silver Fir, *Abies* (*Picea*) *pectinata*, is an excellent stock for all the finer varieties. The numerous species of *Pinus* grow well on stocks of the different types which they most nearly resemble. For example, those species and varieties which resemble the common Scotch Pine (*Pinus sylvestris*)



Conifer Graft (Pinus) inserted.

grow well on that species as a stock, but still better on *P. austriaca*; while *P. monticola* or *P. Lambertiana* and their allies do better on *P. excelsa* or on the Weymouth Pine (*P. strobus*). *P. Pinaster* is a good stock for *P. Lemoniana* and allied kinds. *Cupressus Lawsoniana*, which is readily propagated from seed, and is of clean habit, forms an excellent stock for the dwarf, dense, or variegated forms of Lawson's Cypress. *Keteleeria Fortunei.*—This plant when first introduced bore female flowers only, but in 1875 male flowers were also borne on the original specimen in the possession of

Messrs Rovelli of Pallanza, so we may now expect perfect seeds for the first time in Europe. Nearly all the *Abies* or Firs take kindly to the common Spruce as a stock; while Biotas and Thujas, as a rule, succeed well on the Chinese Arborvitæ. In the 'Revue Horticole,' 1867, M. Briot states that *Libocedrus tetragona* succeeds as a scion on *Saxegothæa;* and its habit, in consequence, becomes changed into a wide-spreading head instead of forming a narrow cylindrical column. *Chamæcyparis obtusa pygmæa*, grafted on *C. Boursieri*, grows erect; while if worked on Biota or Thuja, or if propagated from cuttings, the plants spread horizontally on the ground. *Pseudolarix Kæmpferi* is best propagated by grafting scions on its own roots, moderately thick pieces well furnished with fibres giving the best results. This mode might be used with advantage in the case of other rare Conifers which are difficult to propagate by cuttings. *Salisburia* being a diœcious Conifer, grafting here, as in the *Aucuba*, serves to unite the two sexes on the same plant, and thus insure its fertility. *S. biloba*, from cuttings or seed, forms a good stock—cleft-grafting in March in the open air, or side-grafting in August under glass, being alike successful. Grafting is largely practised in most of the trade collections of Coniferæ, especially for the multiplication of variegated or distinct varieties of any species. Some cultivators object to grafted specimens of Coniferæ; but while acknowledging seedlings to be preferable as a rule, one cannot gainsay the evidence afforded by the fine grafted specimens worked by Mr Fowler at Castle Kennedy, and other well-known cultivators of these ornamental plants and trees.

Stocks for Conifers.—The following list of Conifers will not only be of assistance to the propagator, but also shows the natural affinity of the best known types of Conifers at a glance:—

Scions or Grafts.	*Stocks.*
Araucarias	A. imbricata or A. excelsa.
Cedar	Cedrus atlantica or Larch.
Chamæcyparis	Thuja sinensis, T. canadensis, or T. occidentalis.
Retinospora	Biota orientalis or T. occidentalis.
Thujopsis	Biota orientalis or the last-named Thuja.
Cryptomeria	Cryptomeria japonica.
Cypress	Cupressus pyramidalis or Biota.
Juniper	Juniper virginiana.
Salisburia	Salisburia biloba from seed.
Yew, variegated	Yew seedlings, the Irish yew being preferable.
Cephalotaxus	Cephalotaxus.
Torreya	Torreya seedlings or cuttings.
Libocedrus	Thuja sinensis (seed).
Larch	European or American Larch (seed).

Pine..	P. excelsa, P. laricio, P. austriaca, and P. sylvestris, according to the type of the scion.
Fir................................	Abies, Picea, or Thuja, according to the type.
Thuja................	Thuja canadensis or T. occidentalis.
Biota...............	B. orientalis [illegible] [illegible].
Taxodium	T. distichum.

The Araucarias form a group of stately evergreen Conifers, natives of Chili, Norfolk Island, and Brazil. *A. imbricata*, the "Chilian Pine" or "Monkey Puzzle," is hardy, and a noble ornament to our gardens. All the species are readily raised from imported seeds, which should be sown in well-drained pots of rich fibrous loam, and placed in a pit or moderately warm plant-house to germinate. Although generally considered diœcious, *A. imbricata* not unfrequently bears male catkins and female cones on the same tree, or even on the same branch. This has been observed at Bicton, and also in the Earl of Shannon's Pinetum at Castle Martyr, near Cork, in the spring of 1867. Like other Conifers, Araucarias may be propagated either by cuttings or by grafting. *A. imbricata*, *A. excelsa*, and *A. Cunninghamii* may be propagated from seeds for stocks. In order to obtain cuttings, the leader and principal side branches should be headed in, the portions removed being inserted in sandy well-drained compost, on a genial bottom-heat, in a pit or frame where plenty of air is admitted to counteract damp. Removing the leader and side shoots causes young growth to appear in the upper axils of the decapitated trees, and these can be used either for cuttings or scions. M. Baltet recommends side-grafting with an oblique cleft, or veneering (in February and August, under glass) close to the ground, as the best methods; but neither grafted nor cutting plants are so satisfactory as seedlings—that is, supposing seeds obtainable. *A. imbricata* varies very much in habit when raised from seed, some forms having a dense habit of growth, the branches being produced in close whorls and furnished with lateral branchlets, while other forms are lax in habit, with simple branches. There is a very good series of forms in the Edinburgh Botanic Garden, and also at Elvaston; but the variety in habit assumed by seedlings may be seen in any good tree nursery where these plants are grown in quantity. M. Neuman succeeded in raising plants of *Araucaria Cunninghamii* from root-cuttings; and it is possible—nay, even most probable—that nearly all Conifers could be increased in the same manner. In the case of the Araucaria root-cuttings, they were cut into lengths of two to three inches, their diameter being half to three-quarters of an inch. They require time to

strike, and the best plan is to place the cut roots in pots or pans, and set them in a cool place for a month or six weeks, keeping the soil moist meanwhile, so that they lose not substance by evaporation, and at the end of that time place them on a genial bottom-heat of 60° to 75°.

Miscellaneous Sports. — The descendants of the "Grisly Giant" of the Mariposa Grove (*Wellingtonia gigantea*) are readily propagated by seeds, which are sometimes produced on specimens in English gardens, but more generally they are imported from California.

W. gigantea aurea is a beautiful golden-variegated seedling form which appears to have originated in the gardens at Carraghmore, Ireland. It is a constant and beautiful addition to golden Conifers. At Chatsworth, near the Great Conservatory, a distinct weeping variety of a soft glaucous colour may be seen, and is so ornamental that it deserves propagating either by cuttings or grafts.

A very fine form of *Abies Douglasii* originated at Castle Kennedy about 1872. It is a silver-variegated form of the Douglas Fir, and has been named and exhibited under the name of *A. Douglasii Stairii.* It is said to be one of the brightest and most distinct of all variegated Conifers, and may be grafted on the green type. There are numerous golden-variegated forms of the common Yew (*Taxus baccata*), nearly all having originated from bud-sports. The original tree of the "Golden Yew" is in the Dublin Botanic Garden. The fastigiate kinds are supposed to be seminal varieties selected from the seed-beds for their distinct habit.

A correspondent writing to the 'Gardeners' Chronicle' (see 1872, p. 606) states that the Irish Yew is represented only by female plants, and that he had raised five hundred plants from seed of it fertilised by pollen from the common Yew, the seedlings being intermediate, but none were really so upright and fastigiate as in the type. *T. fastigiata cheshuntensis* is said to be a seedling from the common Irish Yew; and there are also silvery and golden leaved varieties. The Irish Yew is doubtless a chance seedling from the common Yew, and was found in 1780 on a mountain near Benoughlin, whence it was introduced to the gardens at Florence Court, the residence of Lord Enniskillen; and from this solitary example all those now grown have originated.

Mr J. Standish, of Bagshot, exhibited a very beautiful form at one of the South Kensington meetings in 1870, under the name of *Taxus fastigiata aurea*, the foliage of which may be

said to be bathed in gold, and which does not burn in light soils like some of the striped golden kinds. It originated some ten or twelve years ago among a batch of seedlings of the Irish Yew, and like its parent variety, this new golden form has a compact fastigiate habit. A clayey soil and a shady position best suit all the variegated forms of the Yew.

The Bindweed Family (*Convolvulaceæ*).

A group of elegant-habited herbaceous plants, usually of twining or scandent habit, and most abundant in tropical countries—two or three species, however, being natives of Britain. In our gardens they are represented by species of *Calystegia*, *Convolvulus*, *Exogonium* (Jalap Plant), *Ipomæa*, *Batatas* (Sweet-Potatoe). Nearly all the perennial species of *Convolvulus* are readily propagated from root-cuttings, and seeds germinate freely in a gentle heat of 70° to 75°. It is curious to note that some of the annual species of Convolvulus become perennial when grafted on perennial species as a stock; and further experiments in grafting annual and perennial species on each other as scion and stock would be highly interesting. In some cases grafting is the best method of propagating Ipomæas. Sweet-Potatoes are largely cultivated in most tropical countries, and are readily propagated by planting tubers, as in the case of Potatoes. They are planted widely apart, and a secondary or later crop of tubers is obtained by layering the stems. In some cases cuttings are taken off and inserted in a hotbed, where they root readily and form tubers the same season.

Batatas paniculatus is a noble, quick-growing trailer, with deciduous branches and large flowers of a deep rose colour. The thick root-stock of this plant cut into pieces, each well furnished with fibres, forms an excellent stock for *I. Horsfalliæ* and other Ipomæas, which do not seed readily, and are difficult to root from cuttings. The plant is a native of the East Indies, and was introduced prior to 1812.

One of the most graceful and effective of all the hardy species is the large-flowered variety of *C. sepium*, a British species popularly known as the "Hedge Lily." A pink or rosy flowered form has long been known in gardens under the name of *C. americanus* (see 'Bot. Mag.,' t. 733); and these forms might possibly be much improved by raising and selecting seedlings or by hybridising.

The Aucuba and Dogwood Family (*Cornaceæ*).

A group of plants, principally natives of temperate parts of Asia, America, and Europe, and represented in our gardens by Aucubas and Cornels. *Benthamia fragifera* also belongs to this group, and is one of the choicest of hardy shrubs in sheltered localities. Some of the plants in this group are diœcious, as in *Aucuba*, and many species bear ornamental fruits. *Benthamia* may be propagated either by cuttings of the young and partly hardened wood or by layers, and sometimes by seed. The choice Cornels may be grafted on the common kinds or propagated by seeds. By far the most attractive and variable species in this group is the *Aucuba*, one of the most effective of all hardy shrubs.

Aucuba.—A genus of Japanese and Indian evergreens bearing diœcious flowers and bright scarlet berries among their deep glossy green or yellow blotched leaves. *A. japonica*, *A. himalaica*, and others, are commonly met with in our gardens. All the species and varieties may be readily propagated either by cuttings of the young growth or by layers. Cuttings of the young wood with a heel root freely in water in an airy situation. Berries grow freely, but rarely germinate until the second year after sowing. Sometimes a few plants make their appearance the first year, and the berries keep on germinating one after another for two or three years if undisturbed. The fine old Aucubas in the Royal Botanic Garden, Regent's Park, are in one or two cases 8 to 10 feet high, and 10 to 12 feet in diameter, and these fruit freely, a male plant in a pot being supported in the centre of each when in flower. Hundreds of seedlings are raised, about half of which are male plants and half females. The seedlings vary much in habit, size of leaf, colour, and markings. The male and female organs being borne on different plants, it follows that artificial fertilisation is necessary in order to enable them to produce fertile seeds. In favourable localities, placing the male plant in a pot in close proximity to the female shrub is sufficient to induce fruitfulness, the pollen being conveyed by either winds or insects. Some graft branches of the male plant upon the female, while others fertilise the flowers artificially, either with a camel's-hair pencil or by plucking the male flowers and shaking the pollen over the female organs. The last-named method is surest, as often the male and female plants do not flower synchronously in cultivation. Pollen may be kept several weeks in dry silk-paper or tinfoil. The male plants

are propagated by cuttings or by grafting on stocks of the female variety. M. Baltet says: "When stocks are scarce, or wanting, prepare cuttings of *A. japonica*, and at the same time cleft-graft them on the crown or side with the variety to be propagated, placing them under a *cloche*. The graft becomes united while the cutting is forming roots." The *Garrya* may be successfully cleft-grafted or veneered upon the *Aucuba*. Graft under glass in heat from October to February, or bud in August. Where large bushes are well fruited, it is possible to cut off fruiting branches a foot or more in length, and these, if prepared like cuttings, inserted in small pots, and plunged on a gentle bottom-heat of 60° or 65° in a close frame, may be rooted in a month or six weeks. This method is useful for securing fruiting plants in small pots for decorative purposes, and is best performed in November and December, after the berries are fully developed.

The following is a good selection of the male and female varieties; but all the kinds vary from seed quite as much as do Crotons, and some of the varieties of these are nearly as handsome, and quite hardy:—

MALE AND POLLEN-BEARING KINDS.

A. japonica viridis, leaves dark green.
A. bicolor, leaves with golden blotches.
A. maculata, leaves with golden spots.
A. macrophylla, leaves large, bright green.
A. marmorata, leaves blotched with yellow.
A. sulphurea, leaves spotted with creamy yellow.
A. angustifolia, long lance-shaped leaves.
A. angustifolia maculata, long lance-shaped leaves spotted with yellow.
A. himalaica, leaves deep green.

FEMALE OR BERRY-BEARING KINDS.

A. japonica vera, green-leaved type.
A. macrophylla, having larger leaves.
A. viridis, leaves bright green.
A. viridis fructo-albo, green leaves, white berries.
A. longifolia, leaves long, narrow, dark green.
A. latimaculata, leaves blotched with yellow.
A. ovata aurea, broad golden-spotted foliage.
A. salicifolia, leaves long, narrow, glossy green.
A. sulphurea, leaves dotted with creamy yellow.
A. aurea marginata, leaves spotted and edged with yellow.

The Aucuba first fruited in this country in Mr Standish's nursery at Ascot in 1863, Mr Fortune having sent the male plant from Yeddo about a year previously.

Hermaphrodite Aucubas have occasionally been raised from

seed. Mr Standish exhibited a specimen in 1867, and M. Narcisse Gaujard of Ghent obtained a similar example. The hermaphrodite plant had been obtained from the ordinary female Aucuba, and developed a large panicle of hermaphrodite flowers, but we are not told if fruit was produced. In reference to the permanence of hermaphrodite Aucubas, Mr Standish's experience with *Skimmia oblata*—which was formerly hermaphrodite and self-fertilising, but latterly requiring artificial fertilisation—rather militates against the hope of it. The last-named plant also produces unisexual—*i.e.*, male and female—plants from seeds.

The Oak and Hazel Family (*Corylaceæ.*)

A group of trees and shrubs rather diverse in habit and appearance and bearing mostly monœcious flowers, the female flowers being comparatively few in number, and often solitary, while the male flowers are arranged on pendent spikes technically called catkins. They are for the most part natives of temperate countries, while those which are found in equatorial regions grow at a considerable altitude. They are common in Europe, Asia, and North America, and are represented in our gardens and woods by the following ornamental, fruit-bearing, or timber-producing trees: *Carpinus* (Hornbeam), *Corylus* (Hazel-nuts and Filberts), *Fagus* (Beech), *Castanea* (Sweet-Chestnut), *Quercus* (Oaks), and one or two others less well known. Nearly all the cultivated species of this group exhibit a marked tendency to vary when raised from seed; and this is especially noticeable in the seed-beds of Oaks, Beech, Sweet-Chestnut, and Filberts or Cob-nuts: hence the many forms of these now in cultivation. I believe I am right in saying that no direct attempts at hybridism have been made in this country; but one form of Oak (*Q. nobilis*) is said to be the result of artificial hybridisation. Monœcious and diœcious plants nearly always repay the attention of the hybridist, and the species of this order deserve especial notice on that account, as well as for their noble proportions and permanent character. In some cases the seedlings of Oaks, Chestnuts, and Beech appear constant on their first appearance; but eventually latent characters are developed in the form of sports, and these may be perpetuated either by grafting on the typical species as a stock, or by cuttings, the first-named process being preferable. Some of the varieties of Corylus and Beech come tolerably true from seed, and this is especially the case in the

purple-leaved varieties. Mr Mills, of Enys, notes that some six or seven years ago he found seedlings under a Purple Beech, and that these are still equal in colour to the grafted trees from which they were raised. The size to which they have grown—about 8 feet high, with branches from 4 to 6 feet long—sufficiently proves their permanence. It may not be generally known that the edible-fruited and variegated forms of Sweet-Chestnut (*Castanea vesca*) succeed well grafted on young seedlings of *Quercus robur*.

Quercus (Oaks).—A group of ornamental or timber trees, natives of Europe, N. Asia, N. America, and Japan, and represented in our landscape gardens and parks by many sports or seminal forms. The Cork Oak (*Q. suber*) is grown in Spain, its bark being used largely in the manufacture of corks. Oak-galls are employed by ink-manufacturers; and the acorns of *Q. ægilops*, or Valonia Oak, are used by dyers. All Oaks are best propagated from seeds—*i.e.*, acorns, which should be sown in trenches in nursery-beds as soon as gathered, in the case of the hardy American and other kinds, or in boxes or pans in a frame or pit if at all tender. Oaks are found to vary considerably from seed, and some species more than others. Where two or more species are grown in close proximity, this variety is greater, owing, it is presumed, to accidental cross-fertilisation, which is all the more possible in plants of this order, owing to their being monœcious, the male flowers being borne in loose pendent catkins, and the female generally solitary or in few-flowered clusters. Golden-variegated pendulous or other sports are only to be propagated by grafting or inarching, or by cuttings in a close frame, but they are rather difficult to root. Mr Charles Lee recommends inarching as the most successful method of grafting Oaks, as by the common method only about 20 per cent of the grafts take, even when the operation is performed by an expert propagator. Herbaceous grafting might be more successful, using a thin clean blade with a razor-like edge. Attempts might also be made to graft the young growth on fibrous pieces of the thick root in a close frame or under a *cloche*. The Japanese gardeners side-graft their choice Oaks with success.

Seminal Varieties or Sports.—Messrs Ottolander & Son have sent out a seedling Oak, *Quercus nobilis*, "coming from *Q. robur nigra*, crossed with the *Q. americana*. The growth is much like that of *Q. alba*, but it is more robust, and very hardy, the leaves larger, and the young ones of a fine deep red." The golden-leaved *Quercus americana* far exceeds *Quercus robur concordia* in the beauty of the leaf, and was sent out a year

or two ago by M. de Groot of Bruges. Its form may be described as similar to that of the Scarlet Oak, which will convey some idea of the size and beauty of its foliage.

The Lucombe Oak (*Quercus cerris Lucombiana* and *Quercus cerris Lucombiana crispa*).—These two varieties may be seen at the Old Nurseries at Exeter, which are still carried on under the name of Lucombe, Pince, & Co. Neither the ordinary Lucombe Oak nor the variety called *crispa* is ever found without the leaves, as before they shed one year's leaves the new ones are all but fully expanded. There is a history attached to this most beautiful of all the evergreen Oaks. Mr Lucombe found one or two young trees in a seed-bed of the acorns of the Turkey Oak (*Quercus cerris*) which held their leaves all through the winter whilst the rest were quite bare; the above two varieties of the Lucombe Oak were thus discovered. The ordinary Lucombe Oak is an upright-growing tree, whilst the variety called *crispa* is partially pendulous in its habit, the lower branches forming themselves into very graceful curves. There is a tree of this latter variety (*crispa*) at the entrance to the above nursery, measuring 62 feet in height, and 11 feet 4 inches in girth at 2 feet from the ground. The appearance of this fine Oak leads me to suppose that *Q. suber* is the male or pollen parent, its leaves being evergreen and the bark corky in texture. *Q. rubra*, var. *Sada*, is a handsome large-leaved seedling raised by Signor G. Sada, a nurseryman at Milan. It is a seedling from *Q. rubra*, var. *macrophylla*.

The House-Leek Family (*Crassulaceæ*).

A group of hardy and half-hardy succulent plants or shrubs, principally natives of the Cape of Good Hope, Europe, Siberia, and the Canary Islands. The common House-leek, *Sempervivum tectorum*, is one of the best-known examples; and this plant almost always bears ovules instead of pollen in the anthers. Nearly all the species are easily propagated from seeds, which are freely produced if the plants are grown on a dry and sunny shelf in a pit or greenhouse; and these should be sown in moist sandy earth as soon as ripe, and placed in a moist, genial temperature. After germination, place the seedlings in a dry, airy place, as the young plants of this order are apt to rot off in the seed-pan if the atmosphere is too moist. Rocheas, Echeverias, Pachyphytums, Bryophyllums, and many Sempervivums, are readily propagated by inserting the old or fully-developed leaves as cuttings in pans of sand. Offsets are

freely produced, especially when the terminal leader of growth is purposely destroyed, or the top of the plant removed. The following are the principal genera: *Crassula*, *Rochea*, *Kalanchoe*, *Bryophyllum*, *Cotyledon*, *Umbilicus*, *Echeveria*, *Pachyphytum*, *Sedum*, *Rhodiola*, and *Sempervivum*. There is just now a decided revival of public taste in favour of these and other succulents. Echeverias have become very popular in carpet-bedding and other flower-garden arrangements, and numerous hybrids have been raised by English and Continental cultivators, of which more anon. Crassulaceous plants, like most other succulents, are easily grafted; and I have seen *Sempervivum arboreum* used as a stock for some of the dwarf kinds. *Echeveria coccinea* also forms a good stock for dwarf-growing Echeverias or Pachyphytums. Some of the smaller-growing and scandent Crassulas take well to *C. portulacea* as a stock; and plants so worked form very interesting pot-plants for decorative purposes, and attract attention when they would be overlooked on their own roots. Practically, however, the operation leads to no other useful result.

Echeveria.—A very distinct and ornamental genus of succulent plants, having fleshy bluish-green or glaucous leaves arranged in a rosulate or rosette-shaped manner. Nearly all the species are Mexican, and may be increased by offsets or by leaf-cuttings—that is, the old leaves stripped off and inserted in sandy soil or brick-dust. Seeds are very freely borne by well-established plants, and the species interbreed freely. Sow the seed as soon as ripe in pans of light sandy earth, and place them on a gentle bottom-heat until the young plants appear, after which place them on a dry sunny shelf near the light. *E. pulverulenta*, *E. formosa*, *E. gibbiflora*, var. *metallica*, *E. agavoides*, and *E. retusa*, are common in gardens, and very distinct; and if these were carefully hybridised with each other and with *Pachyphytum*, *Rochea*, and other sections of the order, some very useful races of decorative plants would doubtless be the interesting result.

Several of the finest hybrids between Echeveria and Pachyphytum have been raised within the last few years in Continental gardens.

E. pachyphytoides is like a strong-growing *Pachyphytum bracteosum*, but the leaves are flatter; and another seminal form from the same cross, *E. p. rosea*, is similar in character, but the leaves are more pointed, and show more of the glossy rosy hue of the Echeveria.

E. glauca-metallica is, as its name implies, a cross between

E. glauca, now so much used in edging flower-beds, and the large-leaved *E. metallica.* In habit it is exactly intermediate between its parents, and forms a noble plant for the centre of panels and similar positions in carpet-beds.

E. rotundifolia, a strong-growing and very symmetrical plant, nine inches across when fully developed, was obtained by crossing Mr J. Seden's hybrid, *E. glauco-metallica*, with *E. secunda major.* Mr R. Dean first exhibited it at South-Kensington, November 10, 1875, when it received a first-class certificate.

E. Schedeckerii is a neat-habited hybrid of Pachyphylloid habit, and is the result of a cross effected between *E. secunda glauca* and *Pachyphytum bracteosum.*

Mr W. Ingram, of Belvoir, raised a distinct hybrid between *Echeveria secunda glauca* as the male, and *Pachyphytum bracteosum* as the female or seed-bearing parent. Its foliage resembles the pollen-parent, and its flowers the seed-parent. This plant was first shown at a meeting of the Royal Horticultural Society, Oct. 2, 1872.

E. undulata.—This is a hybrid raised by M. de Smet between *E. atropurpurea* and *E.* (*gibbiflora*) *metallica.*

E. retusa glauca.—This is one of Mr Bull's hybrids between *E. retusa* and *E. secunda.*

E. carinata is said to be a hybrid between *E.* (*gibbiflora*) *metallica* and *E. atropurpurea.*

E. luteo-gigantea is a hybrid from *E. retusa* fertilised by pollen of *E. macrophylla*, and was raised by M. Rendatler of Nancy.

E. pruinosa is said to be a hybrid between *E. linguæfolia* and *E. coccinea.*

E. floribunda splendens and *E. miniata* are hybrids raised by M. Rendatler of Nancy; but I cannot lay hands on their parentage.

E. scaphylla.—This is a hybrid raised by M. Deleuil from *E. agavoides*, fertilised with pollen of *E. linguæfolia.*

E. spathulata is a hybrid between *E. bracteosa* and *E. grandiflora.*

It is a curious fact that many of these hybrid Echeverias are more robust than either of their parents; and it would be interesting to know whether they bear perfect—*i.e.*, fertile—seeds, or whether (as is often the case with other hybrids) their vigour is due in some measure to their sterility.

The following hybrid Echeverias were raised prior to 1874 by M. J. B. A. Deleuil (see 'Belg. Hort.,' 1874, p. 329):—

E. clavifolia.—The result of a cross effected by pollen of *E. rosea* (*Courantia Echeveroides*, Lem.) on *E. bracteosa* (*Pachyphytum bracteosum*) as the seed-parent.

E. erecta.—A hybrid between *E. coccinea* and *E. atropurpurea.*

E. ferrea.—A hybrid obtained from *E. Scheeri*, by fertilising it with pollen of *E. calophana.*

E. grandisepala.—Obtained from *E.* (*gibbiflora*) *metallica* fertilised with pollen from *E. rosea.*

E. imbricata.—This is a hybrid obtained from seed of *E. glauca* fertilised with pollen of *E. metallica.*

E. mutabilis.—A hybrid from *E. Scheeri* fertilised with pollen of *E. linguæfolia.*

E. ovata.—Obtained from *E. Scheeri*, the male parent being *E.* (*gibbiflora*) *metallica.*

E. pachyphytoides.—A stately hybrid between *E. bracteosa* (*Pachyphytum bracteosum*) and *E.* (*gibbiflora*) *metallica.*

M. Deleüil sent out the following hybrid Echeverias in 1876:

E. colossea.—The issue of *E. Van Celsii*, impregnated by *E. atropurpurea*, with leaves exceeding a foot in length.

E. cochlearis.—A hybrid between *E. linguæfolia*, female, and *E. atropurpurea*, male parent.

E. mirabilis.—Between *E. bracteosa* (*Pachyphytum bracteosum*) and *E. Scheeri*, having superb opaline leaves tinged with rose.

E. retusa autumnalis.—Obtained from *E. glauca*, fertilised by *E. retusa*, an abundant bloomer in the autumn.

E. securifera.—Between *E. secunda* and *E. macrophylla.*

E. spiralis.—Between *E. decipiens* and *E. californica.*

E. stellata.—The result of a cross between *E. glauca* and *E. navicularis.*

Sempervivum (*House-leeks*).—A large group of succulent plants, represented by the common native House-leek, *S. tectorum*, and many other species in cultivation. They are readily increased from seeds sown on a pan of fine sandy soil, and covered with a pane of glass painted green, after which the pan may be placed on a shelf in a dryish temperature of about 65° or 70°. Seeds of succulent plants do not succeed well if placed in a close and humid case, owing to their extreme liability to damp off. Many of the species, as *S. canariense*, *S. tabulare*, *S. tabulæforme*, and others, may be propagated like Pachyphytums—*i.e.*, by stripping off the lower well-developed leaves and inserting them in well-drained cutting-pans surfaced with sand, after which water them well, and set the pan on an airy shelf in the full sunshine: Some species produce offsets very freely, and these are readily propagated like cuttings. Possibly some of the choice and tender species might be successfully grafted on *S. arboreum* or other tall-growing species as a stock. This genus well deserves the attention of the hybridist, since even in the native habitats of some European

species natural hybrids have been discovered. M. Lamotte, writing in 1862, names seven of these hybrids, as follows:—

S. pseudo-arachnoideum, Lamt. inéd.
S. piliferum, Jord.
S. Jordani, Lamt. inéd.
S. arachnoideo-Boutignianum, Lorr.
S. Boutignianum-arachnoideum, Lorr.
(= *S. rubellum*, Lamt.)
S. arachnoideo-auvernense, Lamt.
(= *S. Pomelii*, Lamt.)
S. auvernense-arachnoideum, Lamt. inéd.
(= *S. villosum*, Lamt. olim.)

It is singular to find that the "Cobweb House-leek" (*S. arachnoideum*) is one of the parents throughout the above series of natural hybrids, having in some cases supplied the seeds, and in others again the pollen. *S. pseudo-arachnoideum* is the most beautiful of the group, having the largest and brightest-coloured flowers; and M. Lamotte believes that the pollen-parent was *S. montanum*, the seed-parent being *S. arachnoideum*. *S. piliferum* and *S. Jordani* are probably born of the same parents; but in these cases *S. montanum* is believed to have been the seed-parent. Apart from these natural hybrids, I find no records of any hybridist having experimented with these plants except M. Donkelaar, who, prior to 1862, succeeded in obtaining a hybrid between *S. speciosum* and *S. tabulæforme*. Of *S. arboreum* there are variegated and purple-leaved forms; but whether these are seminal forms or sports I cannot say. It appears to me, however, that many of the Sempervivums are susceptible of so great variation that they have repeatedly been described as distinct species; and in no one species is this fact more marked than in the polymorphous *S. tectorum* or "House-leek." In 1866 I obtained seven distinct varieties of this plant from the seed of one capsule—some of lax habit and green leaves, some little larger than half-a-crown, and of a deep red colour, and others intermediate. Indeed, many other Sempervivums seem as variable in this way as are Mammillarias, Haworthias, Gasterias, and other succulents.

THE CUCUMBER FAMILY (*Cucurbitaceæ.*)

To this order belong the Cucumber, *Cucumis sativus*, the Melon, *C. melo*, and numerous species and forms of *Cucurbita*, or Gourds, with which may be classed our Squashes

or Vegetable Marrows. The extreme variability assumed by the species of this group is especially well known to gardeners, who find it extremely difficult to keep their stock of Melons or Cucumbers pure,—a state of things which becomes absolutely impossible if more than one variety of each species be grown in the same house or pit. When a really first-rate Cucumber or Melon is obtained, the only safe plan is to banish all others from the garden, and if possible it should be perpetuated by cuttings * rather than by seeds. These plants bear unisexual flowers—*i.e.*, male and female blossoms on the same plant; and this favours cross-fertilisation rather than otherwise. The usual method of propagating Cucurbits of all kinds is by means of seeds, which are profusely borne by both species and varieties alike. New seeds are noted for producing robust-habited plants, whose development tends rather to the production of foliage and vine than fruit; and to counteract this, gardeners prefer old seeds of Cucumbers and Melons, as when their vitality is impaired by age they make a weaker but more fruitful growth. The same end is attained by carrying the seeds in the pocket for a period of, say, five or six weeks, in which time their vitality becomes partially impaired by over evaporation, and a shorter-jointed and more fertile result is obtained. Cuttings of nearly all Cucurbits root readily in bottom-heat, especially during bright sunny weather, if inserted in sandy soil, or better still, sawdust, and covered with a hand-light or close shade. To prevent flagging, sever the lower leaves of the cutting in half, and shade from direct sunshine. Cuttings so treated root in three or four days or a week, and bear fruit in a much smaller state than seedling plants, while the particular sort or variety can of course be certainly relied on. Raising new varieties of Cucumbers, Melons, or Gourds, is one of the simplest of all cross-breeding operations; but the finest varieties rapidly degenerate or become impure unless the precaution above recommended of complete isolation be carried out. The origin of our cultivated Cucumber (*C. sativus*) is not well known, numerous forms of *Cucumis* having been grown in the East for thousands of years. Dr Hooker is of opinion that *C. sativus* had its origin in *C. Hardwickii* Royle, which inhabits the Himalayas from Kumaon to Sikkim (see also Naudin, 'Ann. Sc. Nat.,' l. c. p. 30). We have no well-authenticated case of the *Cucumis sativus* having produced

* The Hon. and Rev. J. T. Boscawen of Lamaran Probus has a remarkably well-flavoured seedless variety of Cucumber in his garden which he has perpetuated by cuttings for thirteen years.

hybrids with *C. melo*, and MM. Segeret and Naudin have repeatedly failed in their endeavours to cross these two species. Major Trevor-Clarke informs me (1875) that a friend of his, Major Mason of Willoughby Hall, has a plant (hybrid half-breed) from the 'big Pumpkin' crossed by a Cucumber. It is fertile, and is now growing for the second generation. It does not appear to be so well known that the Melon and the Cucumber may be grafted on the Vegetable Marrow as a stock; and so treated, they certainly resist mildew in winter much better than when on their own roots. The best plan is to sow Marrow seeds where the Cucumber plants are required, and a week or two afterwards sow the Cucumber seeds each separately in small pots, and when they are large enough, inarch them on to the Marrow stocks a few inches above the surface of the bed. Cucumber seeds should be sown in a genial bottom-heat of 65° to 75°. M. Gaillard has made several interesting experiments in grafting the fruits of different varieties of Gourds and Marrows (see 'Revue Hort.,' 1875, p. 14, 15), from which it appears that the cellular tissues of these fruits unite very readily.

The following are the principal genera as represented in our gardens: *Bryonia*, *Citrullus* (Water Melon or black-seeded Citrullus), *Momordica*, *Luffa* (Towel Gourds), *Lagenaria* (Bottle Gourds), *Cucumis* (Cucumbers and Melons), *Cucurbita* (Gourds and Squashes).

There are hundreds of cross-bred forms of Gourds (*Cucurbita*), Cucumbers, and Melons (*Cucumis*), and M. Germain de St Pierre has raised hybrids between *Lagenaria sphærica*—seedling plants bearing female flowers only—and the Snake Gourd, *L. vulgaris*. After the first fruit which had been fertilised with pollen from the last-named species had set, the seed-bearing parent produced male flowers, and fruit on the same plant were set by fertilising the female blossoms with pollen from their attendant male flowers. All the fruits so closely resembled each other that the operator thought no true cross had been effected. Seed from all the fruits being sown, the fruit produced by pollen from the Snake Gourd were found to be intermediate between both the parents. These hybrids were again fertilised with pollen from *L. vulgaris* and *L. sphærica* (the original parents) and *L. angolensis*, the hybrids being thus fecundated with pollen from three species, and fruit of a similar character resulted from the union, but the seedlings from these were either intermediate between the parent plants or reverted almost entirely to one or other of

the parent species. For further details see the 'Gardeners' Chronicle,' 1868, p. 681. M. Naudin has raised some interesting hybrid *Luffas* and *Cucumises*, and after him M. Segert has been successful in fertilising the Melon (*Cucumis melo*) with pollen from *Cucumis chate*.

The Cycad Family (*Cycadaceæ*).

A curious and beautiful group of decorative plants, which have risen in popular favour since the introduction of Palms, which they resemble in having hard evergreen leaves borne in graceful tufts or masses from a globose or cylindrical Tree-fern-like stem. The principal genera are *Cycas* (example, *C. revoluta*), *Zamia* (*Z. Roezlii*), *Dion* (*D. edule*), *Encephalartos* (*E. horrida*, *E. caffer*), *Macrozamia* (*M. spiralis*), and one or two others of minor importance. A single-stemmed character prevails in this group, although if the stem is cut to pieces or the top removed, lateral buds are developed under favourable circumstances. *Cycas revoluta* often forms fibrous-coated buds near the base of the stem, and these, if removed and placed in heat, root freely and form plants. *C. circinalis*, another elegant-habited species, also fruits occasionally in our gardens (see 'Bot. Mag.,' t. 2826-27, for figures of fruit, &c.) Whenever fertile seeds can be procured, they germinate readily, treated as recommended for Palms. *Dion edule* furnishes very large seeds in its native habitat (Mexico), and from these a kind of Arrowroot is prepared. The seeds of nearly all kinds of Cycads are as readily imported as those of Palms, while their great trunks are also as easily imported as those of Tree-ferns. Some species may be propagated by inserting the fleshy scales of the stem in a genial bottom-heat (see Lind., 'Theory of Horticulture'). We have elsewhere alluded to the great length of time during which the pollen of certain Cycads is supposed to have retained its fecundating powers, but one can never be certain of fecundation having actually taken place in Cycadaceous plants, unless this is proved by the germination of the seed. Mere production of apparently fertile seeds is delusive, since female Cycads freely form seeds without any apparent means of fecundation; and although these are to all appearance perfect, there is no trace of an embryo to be found (see 'Bot. Mag.,' t. 5943). Here again we must pause, for the late R. Brown long ago pointed out that in the large seeds of *Hymenocallis* no embryo is discoverable when the seeds are first

ripened, but after the seeds have lain in the moist earth for some weeks it becomes evident. Is it so with the seeds of Cycads?

Macrozamia corallipes (see 'Bot. Mag.,' t. 5943) has borne fruit in Mr W. Bull's Chelsea Nursery. Owing to the precocity of the male or pollen-bearing plant, its pollen was not made available for fertilising the cones on the female or seed-bearing plant, so in this case the pollen of *M. spiralis* was dusted over the ovules, and apparently fertile seeds were the result. These seeds are the size of thrushes' eggs, and of a warm brown colour. In the 'Florist' I find the following note: "The fertilisation and fructification of *Encephalartos Lehmannii* have taken place under interesting circumstances in the nursery of M. Jean Verschaffelt, of Ghent. The fertile cones of this plant resemble in form and size a large Pine-apple. M. Verschaffelt recently imported from the Cape a number of trunks in a dormant state, and deprived of their leaves. When placed in heat some began to produce fronds, and others inflorescence, male and female. The pollen from the stamen-bearing catkins was dusted over the female cones in the ordinary way, and the result was the production of numerous fertile seeds."

The Sedge or Papyrus Family (*Cyperaceæ*).

A rather large and variable group of grass-like plants, with solid and generally triquetrous or three-cornered stems. The flowers are sometimes hermaphrodite, sometimes unisexual, the anthers being fixed to the filaments by the base (not versatile as in Grasses). They are marsh plants, of little economic value when compared with true Grasses, and are principally natives of barren marshy tracts in northern countries. The Papyrus of the Egyptians (*Papyrus antiquorum*) is one of the most interesting species. They are principally grown in gardens as foliage-plants, and are readily propagated by seeds or offsets. The tassel-like tufts of the *Papyrus* grow readily if cut off and thrown into the water of a warm tank. *Cyperus laxus*, *C. alternifolius*, and its variegated variety, are readily propagated by cutting off the umbrella-like tuft of leaves at the apices of the flowering stems, as these throw out numerous offsets or young plants, if pegged down on pans of moist sand, or if floated in a tank of tepid water. *Carex* and *Isolepis* are readily multiplied by division.

THE SUNDEW FAMILY (*Droseraceæ**).

A small group of exceedingly curious plants, which have been termed "insectivorous," from their habit of entrapping flies and other small insects. They are for the most part delicate little herbaceous plants set with viscid glandular hairs, and represented in our gardens by the Droseras of Europe, Australia, and the Cape, the Portuguese *Drosophyllum lusitanicum*, one of the very few plants having revolute vernation (see 'Bot. Mag.,' t. 5796). *Dionæa muscipula* is a pretty little white-flowered plant, having flat expanded petioles and highly sensitive leaves. All the plants are well worth culture, and the British *Drosera rotundifolia* is a little gem when seen luxuriating on living sphagnum moss in the cool Orchid-house, each leaf being like an emerald set with a thousand little rubies.

Dionæa.—A curious genus of irritable or fly-catching plants, one species, *D. muscipula*, or "Venus's Fly-trap," having long been grown as a curiosity in our gardens. This plant is a native of N. America, and especially of the mossy swamps of Carolina, and grows best in a cool moist atmosphere. It is readily propagated in the spring. Shake out the plant and remove the top or crown of leaves, which, inserted as a cutting in a close humid case, soon throws out roots. Some propagators use a compost of sandy peat, leaf-mould, and sphagnum for this plant, but the leafy tops will root freely laid on a bed of living sphagnum moss in a close case. The thick portion of the old stem, or root-stock, is covered by the bases of old leaves, and this should be cut into small pieces with a sharp knife or scissors, taking care to leave the scaly base of a leaf or an eye to each portion, however small. These pieces may be sown in a prepared cutting-pot like seeds, and placed on a shelf in a cool airy house, and watered occasionally to keep the soil moist. Every piece will grow, and the young plants may then be potted in sandy peat and living sphagnum, and will make a vigorous growth in a cool frame or pit during the summer months plunged in living moss. Seeds are freely produced on well-grown old specimens, and vegetate freely sown in light soil in a cool frame or airy greenhouse. This curious plant was introduced in 1768, and is well figured in Darwin's 'Loves of the Plants,' and in the 'Botanical Magazine,' t. 785.

* For a memoir on this order by M. Planchon, see 'Ann. Sc. Nat.,' 3 ser., ix. 79.

Drosera.—A genus of very interesting herbaceous plants, represented in this country by *D. rotundifolia*, which is tolerably plentiful in northern bogs. Several species are found at the Cape, and they are also abundant in Australasia, having been imported from the Swan river. Their long forked or spoon-shaped leaves are formed of spongy cellular tissue, and furnished with viscid glandular hairs, in which insects often become entangled. Nearly all the species seed freely, even in cultivation; and seeds germinate readily in a genial bottom-heat if sown like Calceolaria seeds on the surface of a well-drained pan of sandy compost mixed with living sphagnum moss, or even on the surface of a pot covered with sphagnum alone, and covered with a bell-glass. The best way to reproduce them, however, is by cuttings of the roots. This plan has succeeded with *D. binata* in the Edinburgh Botanic Garden, and is thus described by Mr J. M'Nab: "Mr Robert Lindsay, the plant foreman in the Royal Botanic Garden, thought he would try to increase this curious Sundew by root-propagation. The roots for the purpose of propagation are generally taken from strong-growing plants during the process of crown-division. They are of a clear black wiry consistency, and are cut into numerous pieces from half an inch, an inch, or more in length. These are laid on the surface of shallow earthenware pans or flower-pots, prepared with a mixture of sandy peat soil, and are covered about half an inch deep with the same mixture. They are then covered with a bell-glass, and are placed in a damp warm propagating house. In the course of a fortnight, swellings begin to appear on the surface of the detached roots, which increase in length till they reach the surface of the soil. This generally takes place about five weeks after they are put in. When the leaves become developed, they are mostly of a binate form, and soon cover the surface of the pan as if they had been a crop of seedlings. When about two inches or so in height, they are separated and put into small pots, in a similar mixture of soil to that in which the roots were originally placed, with the addition of some chopped sphagnum moss freely mixed through it. If carefully attended to, they soon make excellent plants, and are eagerly sought after on account of their peculiar appearance."

The Date Plum Family (*Ebenaceæ*).

Trees and shrubs the wood of which is remarkably heavy and black in colour, sometimes streaked with red or brown

lines. Ebony and ironwood belong to this order. From a horticultural point of sight they are interesting as affording edible fruits, the best being furnished by *Diospyros kaki*, or Chinese Date Plum, and its numerous cultural forms.

The Persimmon (*Diospyros virginiana*), several varieties of which are found in America, forms an excellent stock on which to graft the finer varieties of the Chinese or Japanese Date Plum (*D. kaki*). Several other species of *Diospyros* bear edible fruit (see 'Gard. Chron.,' 1871, p. 9, and 1872, p. 576). *D. kaki*, var. *costata* (see 'Revue Hort.,' July 16, 1871) has been recommended for orchard-house culture in this country, and bears very handsome orange-yellow fruit the size of Apricots. Fruit of this variety have since ripened in the Isle of Wight, and are figured in the 'Gardeners' Chronicle,' 1875, p. 777. A new species—*D. Mazeli*—is figured and described (see 'Revue Hort.,' 1874, p. 70, 71), and has been introduced into the south of France from Japan. The fruit is delicious, with a flavour like Apricots (see also 'Jour. of Botany,' 1875, plate 171, and p. 353). In the 'Illustration Horticole,' 1874, p. 139-142, M. André contributes a short paper on Date Plums, which is worth notice.

The Heliotrope Family (*Ehretiaceæ*).

A small group of trees or shrubs, mostly tropical, the best-known representative in our gardens being the deliciously fragrant Peruvian Heliotrope.

Heliotropium (*Cherry-pie*).—A small genus of low-growing annual or suffruticose perennial plants, represented in our gardens by the common Heliotrope (*H. peruvianum*) and many beautiful and fragrant seminal forms, which have for the most part originated in Continental gardens. They are natives of Chili, Peru, India, and other tropical or subtropical countries.

Heliotropium peruvianum is a deliciously-perfumed ever-blooming old plant, introduced to Paris by Jussieu the younger, who forwarded seeds; and in Miller's Dictionary it is described as having flowered and perfected seeds at Kew at a later date (see 'Bot. Mag.,' t. 141).

H. corymbosum (see 'Bot. Mag.,' t. 1609), a much larger flowered plant, was also introduced from Peru in 1812; but its showy lilac-tinted flowers are not fragrant. Considerable improvement might possibly be effected by hybridising these two species, so as to obtain a race with larger flowers than *L. peruvianum* and equally fragrant.

Cuttings of the young growth an inch or two in length root freely in heat, and seeds germinate readily if sown as soon as ripe in a genial bottom-heat of 75°.

THE HEATH AND RHODODENDRON FAMILY (*Ericaceæ*).

A very beautiful family of flowering shrubs, represented in our gardens by numerous species (and in many cases varieties) of *Arbutus*, *Andromeda*, *Azalea*, *Erica*, *Rhododendron*, and *Kalmia*. The plants throughout this family are remarkable for their beauty when in flower; and the strawberry-like fruit of the Arbutus is also very ornate in autumn when seen among the waxy bell-like flowers and glossy foliage. Although much has been done in this order, there yet remains a large field for the hybridiser who intelligently goes to work among the Ericads. *Ericas* have been hybridised repeatedly, some of the best of all the exhibition kinds having been either seminal varieties or hybrids; and the same may be said of Epacrids, Rhododendrons, and Azaleas; although in the case of Azaleas numerous forms have been secured in Italian, Belgian, and French gardens by perpetuating sports by grafting. Indeed, Azaleas seem to "break" nearly as freely as Tulips or Carnations.

Arbutus.—We have three species common in our gardens—*A. andrachne*, a native of the Levant; *A. procera*, a North American species of strong growth, which, like the last, casts its outer bark every year; *A. unedo*, the common Arbutus, is abundant near Killarney, and in South Europe along the shores of the Mediterranean. All the species are propagated by layering or seeds; cuttings also root tolerably well on a sheltered north border. Although there is an *Arbutus hybrida*, and a variety named *A. Millerii*, supposed to be of hybrid origin, I cannot find any records of their parentage. There are double-flowered, narrow-leaved (*salicifolia*), entire-leaved (*integrifolia*), and curled or crisp-leaved (*crispa*) forms of *A. unedo*, all interesting as variations. *A. Croomei* is a handsome large-flowered form, with delicate wax-like rosy flowers; and *A. coccinea* is another highly-coloured form of the type, and these also may possibly be hybrid or seminal varieties. The rare species or varieties may either be inarched or budded on seedling stocks of the common types or of *A. pyrenaica.* Two-year-old stocks are best, and grafting should be performed in a close case, taking care to harden off the plants gradually after the operation is complete. The union takes place rather slowly, and

veneer, splice-grafting, or inarching are the best methods to adopt. There are several South American species, and the hybridist might do worse than improve *A. unedo.* It might possibly cross with the Andromedas, and its habit be so improved. In a dwarf state, covered with waxy flowers and orange-red fruit at the same time, a dwarf seedling or other form of this would be invaluable as a decorative plant.

Andromeda.—A genus of ornamental flowering shrubs from North America, South America, and China. They are represented in our gardens by *A. floribunda*, a well-known white-flowered species, and others. They are all propagated by layering like Arbutus, the old stems being headed off, and then the bases of the young shoots are covered with soil (see "Hillock Layering"). Seeds, when obtainable, germinate readily in pots or pans of moist earth, and this is facilitated if the pots are placed on a genial bottom-heat. Hybridising would doubtless produce improved varieties from such parents as *A. floribunda*, *A. formosa*, *A. polifolia*, *A. racemosa*, and others.

Azalea.—A well-known and deservedly popular genus of hardy or greenhouse shrubs, partly deciduous, and in some cases evergreen, *A. indica*, *A. sinensis*, *A. amœna*, *A. pontica*, and *A. viscosa* being well-known examples in cultivation. *Azalea indica* (see 'Bot. Mag.,' t. 1420) appears to have been grown in England since about 1812, but had been brought to Holland twelve years earlier. It is a native of China, where it has long been cultivated. The tender varieties of *A. indica* and *A. amœna* are readily propagated from cuttings of the young shoots in the spring. Some prefer shoots about two inches in length, having a heel of the old wood. The hardy kinds are easily multiplied by layering. All the greenhouse varieties of *A. indica* are multiplied by grafting new or rare kinds on a robust-growing variety as a stock, and in this way saleable plants are obtained quickly. *A. phœnicea*, *A. rosea elegans*, *A. Sir C. Napier*, or *A. alba*, form good stocks, and strike freely from cuttings. They are fit for working when as thick as oaten straw. Grafting may be performed throughout the autumn, winter, and spring months, either side, cleft, or splice grafting being the methods adopted, the stocks being grown in small pots; and these are plunged in a moist genial bottom-heat, in a close case, after the grafts are inserted and tied in, the end of a young shoot with four or five leaves being selected as a scion. Many of the new varieties have originated from sports, which are readily perpetuated by grafting; and Mr Fortune informs me that in China and Japan the gardeners have many varieties

which have originated in this manner. Seeds are readily produced by most of the single varieties if fertilised artificially. Any two striking varieties may be crossed, and as a rule seed germinates freely sown in pots or pans, plunged in a genial bottom-heat. Hybrids between *A. indica* and one of the yellow-flowered species are much to be desired. Some years ago, indeed, they were considered as likely to form the types of a new race remarkable for their ample flowers and brilliant colours, Mr Smith of Norbiton having succeeded in obtaining a race of seedlings between *Rhododendron ponticum* and *Azalea sinensis*, these having yellow flowers, but larger and brighter than those of the last-named parent (see Herbert's 'Amaryllidaceæ,' p. 359). M. Souchet also succeeded in obtaining a hybrid from *Azalea Damelsii* fertilised with pollen from a Rhododendron; and Azalea Comte de Hainault, a variety having double flowers of a carmine colour, is said to be a hybrid between *A. indica* fertilised with the pollen of a Rhododendron. These two genera offer a wide field of labour to the intelligent hybridist, as the species and forms of each are so diverse and so easily cultivated.

A very fine double-flowered white variety named "Flag of Truce" was sent out by Messrs Smith of Dulwich, about five years ago, and double and semi-double forms are now common; and such varieties as "Imbricata," "Borsig," and others, are better adapted for cut flowers than the single kinds, as the flowers last longer and are more persistent. These varieties are easily propagated by splice-grafting on seedling stocks. It is singular to note that while the origin of double Azaleas is comparatively recent in our gardens, a double rosy variety of *Azalea sinensis* was introduced from China in 1819 (see 'Bot. Mag.,' t. 2509. This bore clusters of bright rosy flowers, and would be now highly esteemed by many as a decorative plant. *A. Caldwellii* was obtained by Messrs Caldwell by crossing *A. amœna* with *A. indica.* "W. Carmichael," "Mrs Carmichael," are varieties raised by Mr Carmichael, and are the result of crossing *A. indica* "Stella" with the bright purple early-flowering *A. amœna.* These hybrids made their appearance in 1875, and the two last were sent out by Mr B. S. Williams.

A year or two ago Mr W. Tillery, writing to the 'Florist,' says: "I was successful with a cross between *Rhododendron Aucklandii* and the *Azalea indica* "Stella," making "Stella" the female parent. The pollen from the short anthers of *Aucklandii* was used in this cross. I have young plants now (1874) growing vigorously from the seeds so produced,

and hope to see some of them flower next year. All the difference I see in them at the present time is that they are stronger in growth and with larger foliage than other young seedling Azaleas sown at the same time. I selected 'Stella' for experiment in this case, as it is a very strong-growing variety and of fine habit, and also for the colour of its flowers."

Mr Tillery has also succeeded in crossing *Azalea mollis* and *A. sinensis*, and the seedlings are healthy, but have not yet flowered. In writing to the 'Florist,' 1875, p. 282, the same hybridist remarks: "I have fertilised some flowers of *Azalea indica* 'Stella' with the pollen of *A. mollis*, and the seed seems swelling well, so that there is a chance of a new strain in Azaleas." Although most of our improved varieties of Indian Azaleas have been imported from the Continent, and especially from Belgian gardens, it is interesting to find that Mr Phillips Frost (now of Dropmore) raised some fine seedlings, which were sent out by Knight and Perry of Chelsea many years ago (1830-40). Mr Frost sowed seed from a white variety, and this, without any artificial cross-fertilisation on his part, produced offspring of various colours. Among this batch of seedlings at least four were named and distributed, these being *A. Frostii*, *A. Grenvillei*, *A. Chelsonii*, and *A. Duke of Devonshire.* These varieties must have been among the earliest seedlings raised in this country.

The hardy varieties known as American or Ghent Azaleas are hybrids or selected seedlings which were originated at Ghent, whence the popular name, and they are all varieties or hybrids of *A. calendulacea*, *A. speciosa*, *A. viscosa*, and *A. nudiflora.* Seed should be sown in pans of light sandy soil in the spring, and placed in a gentle bottom-heat. When the young plants make their appearance admit air after watering, as they are apt to damp off; indeed it is a tendency to rot off or decay at the collar which renders grafting on *A. phœnicia* as a stock necessary, in multiplying and perpetuating all the finer and more tender varieties. Artificial fertilisation is the surest way of obtaining any particular improvement in shape, habit, or colour of the flower; but seed taken promiscuously from selected varieties gives a fair percentage of good flowers. Azaleas seed so freely that the seed-vessels are carefully removed from specimen plants after flowering in order to husband their strength for future bloom. *A. hybrida enneandra* (see 'Bot. Mag.,' t. 2308) is supposed to be a natural hybrid between a white-flowered Azalea accidentally fertilised by the pollen of *Rhododendron ponticum*, which stood near it. Raised from seeds of the Azalea, the habit of the plant is that of a

slender-habited Rhododendron, with elegant white flowers like those of a Rhododendron in form, and suffused with lilac. *Rhododendron hybridum glaucum* (see 'Bot. Reg.,' t. 193) is a hybrid between an Azalea and *R. maximum*, the latter being the pollen-parent. This differs from the above plant in having glaucous leaves and an erect arborescent stem. *R. azaleoides* is supposed to be a mule between an Azalea and a Rhododendron (see 'Bot. Mag.,' t. 2308). Mr J. Anderson-Henry has raised hybrids between Indian Azaleas and Rhododendrons, and the same result has been obtained by Continental growers between Rhododendrons and the yellow-flowered *A. sinensis*. This close relationship or consanguinity might be turned to useful account by using seedling Rhododendrons as stocks for Azaleas to increase their vigour; and, *vice versâ*, to limit the exuberance of the Rhododendron, and induce it to flower earlier and in a dwarf state. Several handsome cross bred varieties of *Azalea mollis* are figured in 'Flore des Serres,' 1874, p. 155-161, and these figures will always be interesting, as showing the range of improvement hereafter effected by future cross-breeding and cultivation. The Indian Azaleas have ten stamens, while the Ghent and American varieties have but five; still, for all practical purposes, they are identical. Numerous seminal forms of *A. laterita* have been produced in Continental gardens; and it is interesting to find that a baker of Ghent, M. Mortier, occupied his leisure in crossing the Turkish *A. pontica* (of which there are natural varieties varying in colour from yellow and white through all the shades of orange to a deep bronze or copper colour) with the N. American *A. calendulacea*, *A. viscosa*, and *A. nudiflora*, and so originated a very brilliant and useful group of hardy decorative plants. Azaleas may now be considered in the same category with Pelargoniums, Pansies, Cinerarias, and other florists' flowers, since there appears to be no limit to the seminal varieties they bring forth; and even the plants "sport" or "break," as is the case with tricolor Pelargoniums and some other plants.

Erica (*Heaths*).—A well-known family of decorative plants, some being natives of Europe, but the finest species come from the Cape of Good Hope. Cape Heaths have not resisted the pervading influence of the great law of nature. Mr Storey, formerly of Isleworth, produced some remarkable plants of both Erica and Epacris forty or fifty years ago: of the former, some varieties of the section belonging to *E. vestita* were especially ornamental; and of the latter were varieties, with tubular flowers, resembling *E. impressa* and *E. grandiflora*, of very great beauty.

Some of the very best varieties of *Erica ampullacea*, *E. tricolor*, and *E. jasminiflora*, now in cultivation, are also of hybrid origin. They are readily propagated by cuttings of the young wood inserted in cutting pots surfaced with silver sand, and placed in a dry position in the greenhouse or frame. Too much heat and moisture in the atmosphere causes the cuttings to damp off. The pots of cuttings should be covered with a bell-glass, tilted at the base so as to prevent closeness and damp. Although this genus has been much improved by the hybridist, there is yet a wide field open to the cultivator.

In fertilising Ericas, it should be borne in mind that the eight stamens shed their pollen early—sometimes, indeed, before the flower opens; and to prevent the possibility of self-fecundation taking place, a slit should be made through the unopened corolla, so that the stamens can be cut off with a pair of fine-pointed scissors, and removed from the flower, after which examine the glutinous apex of the stigma with a lens; and if it is in a receptive state, and free from the pollen of its own flower, proceed to fertilise it with pollen obtained from any other parent the properties of which it seems desirable to blend with those of the seed-bearing parent. Some of the Cape Ericas, however, retain their pollen until visited by insects, the anthers being irritable, and when touched by the proboscis or antennæ of a bee or fly, they discharge their pollen on to the hairy intruder, who thus doubtless cross-fertilises other flowers, and possibly other species. Seed should be sown as soon as it is ripe on the surface of sandy peat earth, and covered with a bell-glass. It will germinate more quickly if placed on a gentle bottom-heat in a greenhouse temperature.

As early as 1819 the Rev. W. Herbert had obtained numerous hybrid Heaths, since in his valuable paper (see 'Trans. Hort. Soc.,' 1819-21, vol. iv. p. 28 *) he writes: "I have mules from the long-podded *Erica ampullacea* and *E. jasminiflora* (fertilised?) with the round-podded *E. vestita-coccinea* and *E. hybrida* or *cylindrica*. I have also mules from *E. Shannonii* with *E. gemmifera* and with *E. tricolor*, of *E. ampullacea* with *E. gemmifera*, and all the seedlings of a similar impregnation are alike among themselves, and would at once be pointed out by a person acquainted with the African Heaths as new species extremely unlike their parents. These have not yet flowered. I have not yet obtained any mule between tubular and campanulate flowering Heaths; but I have not made many experiments. I think such difference of form much more likely to

* See also "Observations on Hybrids," by T. A. Knight—'Trans. Hort. Soc.,' vol. iv. p. 367.

constitute a true distinction in the family of Heaths than that of a longer or rounder capsule. The unwillingness of the African Heaths to shed their pollen unless touched by a strong insect or humming-bird, must render them very likely to be fecundated by the pollen of neighbouring sorts; and if the hybrid offspring should prove fertile like that of the Gladioli, it will be evident how it comes to pass that the species of African Heaths are so multiplied, while the European sorts remain unaltered.

There are two or three hundred reputed species which have been at one time or other introduced into our gardens, and such kinds as *E. tricolor*, *E. ventricosa*, *E. vestita*, and others, have yielded numerous beautiful varieties. Among others, Mr Epps, Messrs Rollison & Sons, Messrs Lee of Hammersmith, and Mr Turnbull of Bothwell Castle, have done much towards improving the Ericas as decorative plants. Mr Turnbull has raised numerous beautiful hybrids.

The following is a list of hybrids raised by Messrs Rollison, who have long held the finest collection of hybrids and species in the trade:—

Erica æmula.
" affinis.
" amabilis.
" " floribunda.
" ampullacea obbata.
" " rubra.
" aristella.
" blanda.
" Bousteadiana.
" Burnettii.
" Candolleana.
" Cavendishiana.
" Clowesiana.
" eximia.
" " superba.
" Fairreana.
" fastigiata lutescens.
" favoides elegans.
" ferruginea superba.
" gemmifera elegans.
" Hartnelliana.
" " virens.
" Holfordiana.
" hybrida (cylindrica).
" Irbyana (non-Andrews).
" Jubana rubra.
" Lindleyana.
" M'Nabbiana superba.
Erica metulæflora.
" " bicolor.
" " superba.
" Paxtonii.
" perspicua nana (buccinæformis)
" picturata.
" princeps coccinea.
" profusa.
" retorta major.
" Sindryana rubra.
" Sprengelii.
" suaveolens.
" tricolor.
" " coronata.
" " elegans.
" " flammea.
" " Holfordii.
" " impressa.
" " inflata.
" " Kingscottiana.
" " major.
" " Rollisonii.
" " superba.
" tubæformis.
" venosa.
" vernix coccinea.
" vestita carnea.
" Victoria.

The following are modern varieties raised and sent out by Messrs Rollison & Sons since 1871:—

E. rutilans.—A beautiful variety raised at the Tooting Nursery, and flowered for the first time in 1871. It is the result of seed obtained by crossing *E. Massonii major* with one of Messrs Rollison's previous seedling varieties, *E. Taurreana.* The foliage is intermediate, but the flowers resemble those of *E. Massonii major* in shape, colour, and arrangement, and are of a bright crimson colour. 1871.

E. effusa.—This plant is the result of crossing *E. Marnockeana* and *E. princeps templea*, but is quite distinct from both in habit. The flowers are in clusters, long, tubular, and of a clear crimson colour, the petals being pink and white, with a dark ring near the mouth of the tube. 1875.

E. opulenta.—*E. Fairreana* and *E. cerinthoides coronata* are the parents of this variety, which is quite distinct from either in habit and flower. The crimson tubular flowers are inflated at the base, having a dark ring near the mouth, and are borne in whorls of 12-16 flowers. The petals are pink and white. Leaves small and hairy. 1875.

E. ornata.—A delicate-coloured variety between *E. obbata* and *E. Fairreana.* The flowers are smooth in outline, French white in colour, shaded with pink at the inflated base of the tube, and banded with green near the throat. Petals smooth, and nearly white. Habit robust, resembling *E. ampullacea* or *E. obbata.* 1875.

E. Shannonii glabra.—A robust variety resulting from a cross effected between *E. obbata* and *E. ampullacea obbata.* The most singular point about this plant is the absence of any viscidity or gum on the flowers, and yet they have a gloss like polished ivory. This is an advantage, as the viscid-flowered varieties are so easily soiled by dust and flies. The flowers are paper-white, suffused with rose, and borne in terminal whorls of 6-8 blooms. 1875.

E. tricolor profusa.—A distinct plant, the result of crossing *E. Fairreana* and *E. princeps coccinea,* totally different from its parents, about which some doubts might have arisen had not the pedigree been carefully preserved. Flowers tubular, inflated, crimson at the base, the upper half white, having a band of green around the throat. The habit is vigorous, branching, the foliage being erect and hairy. 1875.

Mr T. Jackson of Kingston raised and sent out many new and distinct hybrid Ericas. *E. cristata vittata* was raised between *E. cristata major* and *E. Linnæoides*, and was sent out in 1842, as also was *E. Jacksonii*, a hybrid between *E. retorta* and *E. Irbyana.* *E. hiemalis*, one of the finest of all winter-blooming Ericas, is a hybrid raised about 1838.

A double-flowered Heath, in the shape of a sport from *Erica hiemalis*, appeared upon a plant growing in Haynes's Nursery at Penge in 1873. The doubling consists in the repeating of the corolla over and over again, to the exclusion of the stamens and pistil. In the centre is a small shoot bearing scale-like leaves. The clear white of the inner petals contrasts nicely with the pink tinge of the outer whorl; and altogether it is well worth the attention of horticulturists.

Kalmia.—N. American hardy shrubs of dwarf habit, flowering very profusely in the spring or early summer, and readily propagated by cuttings of the young growth inserted in a bed of soil surfaced with sand or grit, and covered with a hand-light or frame. Cuttings taken off in August root best. Seeds grow freely treated as recommended for Rhododendrons. Seedling plants of the common kinds may be employed as stocks on which to graft or inarch the rarer kinds. I believe nothing has been done in the way of hybridising, so that this field is open; and few plants present more attractions, for the flowers are unrivalled in purity and beauty by any other exotic. The flowers resemble little white umbrellas, the eight stamens forming the ribs, the end of each being deftly tucked into a little pocket or angle in the corolla. A cross might possibly be effected between Kalmia and Arbutus or Andromeda—at any rate, the attempt is worth making; or perhaps the Arbutus might be used as a stock on which to graft Kalmias or Andromedas, or *vice versâ* (see 'Amer. Agric.,' July 1876).

Menziesia.—A genus of dwarf-growing shrubs nearly related to the Heaths, which they also resemble in size, and in their spires of well-shaped white, bluish-lilac, or rosy-striped flowers. They are natives of North America, North Europe, and other countries, and are generally found on dry heathy moors. *M. polifolia*, St Dabeoc's or Irish Heath, is found on the granite mountains of Galway; and *M. cærulea* is found in Scotland as well as in North America. These pretty little plants may be propagated from seeds; but in some cases artificial fertilisation is necessary to insure a supply of these in a fertile or perfect state. Cuttings of the young growth may be struck in sand in a cold frame under a *cloche* or bell-glass. Seeds should be sown as soon as ripe in a pan of sandy peat, and placed in a cold frame to germinate. The seeds should be sown thinly, so as not to overcrowd each other in the pan, as they are very impatient of being moved until they have made considerable growth. The bell-shaped drooping flowers are very lovely. *Bryanthus erectus* is a hybrid, the parents being *M. cærulea* and *Rhododendron chamæcistus.* They might doubtless be crossed with some of the hardy Ericas, and a more beautiful race of hybrids be thus obtained, having a more robust habit.

Rhododendron.—A very beautiful genus of evergreen flowering shrubs, represented in our gardens by numerous hardy varieties. The species are natives of North America, the Caucasus, Gibraltar, Java, Borneo, China, Japan, and the Sikkim Himalayas, whence Dr Hooker introduced seeds of so many fine species about 1848. All the species may be propa-

gated by cuttings of the young wood, just as it gets firm at the base. These should be pricked into pans of sandy soil, and placed in a warm frame or pit for a week or so previous to setting them on a gentle bottom-heat. If only one or two individuals are required, then propagate by layering. Grafting is often the quickest and best method of propagation; and *R. ponticum*, or any other hardy variety, may be raised from seed for stocks. Clean seedling stocks are best, and grafting can be performed in September or later, side or veneer grafting being the best methods, as then the top of the stock need not be headed down. A close frame or a pit slightly heated should be used in which to conduct the operation; and the stocks should be established in pots for choice varieties. Inarching succeeds well from April to September, and is often best and surest where the parent plant is small and portable. The hardy kinds may be propagated readily by grafting, the stocks being taken up in March and grafted either by side or splice grafting, after which lay in the stocks by the heels, and cover either with a frame or hand-lights until the union is complete, which will be in about a month or six weeks. Some graft the stocks at 9 to 10 inches from the ground in the open quarters, and others graft at the collar in August, covering the junction with soil. In grafting, tie the scion firmly, and exclude air by a coating of mastic or grafting wax. Scions are formed of the young growth after it has become partially hardened at the base.

The late Mr J. Standish recommends grafting in heat in January, February, and March, or in a cold frame in April; but in the latter case the grafts require to be cut in February, and stuck in a north border, protecting them with a bell-glass or hand-light. Stocks are two-year-old seedlings, with clear fresh stems, and these can be worked if desirable within an inch or two of the collar. Saddle-grafting is the best in heat, and forms the firmest and most intimate union. For grafting, the stocks are taken up from the nursery rows, and after being worked and tied firmly, they are carefully planted in boxes of light rich earth, and placed in a close case in the propagating house or stove until a union is effected. Side-grafting in August is also successful, the stocks being potted and grafted in heat as above, but not headed back as in saddle-grafting; and they require to be kept under glass until the spring, while those worked earlier in the year can be planted out in October (see 'Gardeners' Chronicle,' 1871, p. 308).

The seeds should be sown as soon as they are ripe in a slightly-heated frame or pit on a bed of fine soil, or if the quantity is small, in pots, boxes, or pans. Some prefer to keep the

seed until March before sowing; and in September of last year I saw fifty thousand seedlings in Methven's Nursery, Leith Walk, Edinburgh, which had been sown the March previous, and these had been pricked off when an inch in height. The seed germinates in a month or five weeks, and may be pricked off into beds of light rich earth in cold frames or pits as soon as large enough to handle. Seed of tender warm greenhouse kinds should be sown in a gentle heat in pans, and kept near the light in a warm pit or vinery after germination; and when large enough, they should be potted off into small thumb-pots.

The Pontic and Catawba species are quite hardy; and it is by using these that hybridisers have been able to obtain a hardy race by crossing them with the finer-flowered and brighter-coloured Indian kinds, such as *R. arboreum*, and its white, rosy, cinnamon, and blood-coloured forms. When *R. arboreum* was first introduced, it was only seen in conservatories and plant-houses; but the bright and beautiful colours of this and other Indian varieties set the hybridisers to work, and so successful have they been, that by continual crossings with the hardier varieties from different parts of the world, such as *R. ponticum*, *caucasicum*, *maximum*, and *catawbiense*, they have stamped a vast variety of shades of beautiful colours upon a race which, for hardiness and usefulness in garden decoration, cannot be excelled in any other genus of plants. Better than all, these modern hybrids are by no means so particular as to soil, and many of the best of them may be very successfully grown in fibrous loam, decayed leaves, and sand intermixed. The foliage and manner of growth will generally indicate how much of the Indian type prevails in the variety; and in proportion as that type is predominant, so will the plant be particular as to soil and climate. A wet and frosty winter after a warm mild autumn is a severe test of the hardiness of Rhododendrons. As a rule, the sorts which have *arboreum* blood in their veins perish—generally root and branch; while those of the *ponticum* strain sustain much injury to their blossoms. It is only those bred from *catawbiense* that escape with impunity, and these in a greater or lesser degree in accordance with the influence of their ancestors, in cases where intermixture of blood has taken place. The pallid, lilac-hued *Everestianum* and *roseum elegans* are two sturdy and hardy sorts; but some of the higher-coloured varieties also, of quite modern date, seem able to brave all weathers with impunity. Among those of this category are the rosy "Lady Armstrong," the rosy-scarlet "James Bateman," the rich crimson "Mrs Milner," and "H. W. Sargent"—all remarkably attractive flowers, together with

"Mrs John Clutton," the gem of all others amongst the whites, and "Caractacus" amongst the purplish crimsons. We have here half-a-dozen sorts which are comparatively new, and which it would be very difficult to beat, taking into account their high and pure colours, their magnificent flower-trusses, and their fine hardy Laurel-like foliage.

It is the duty of the hybridiser to infuse a good constitution into his creations, just as it is to improve them in form and colour; hence he should be a close observer of the effects of temperature and exposure on the plants he attempts to improve, so as to enable his seedlings to withstand our climate with impunity; and this particularly applies to the hardy varieties of Rhododendron.

In crossing Rhododendrons, the hardiest and best-habited plants should always be selected as the seed-bearing parents; and *R. catawbiense* or *R. maximum* are the best in this respect from which to originate races; but if the object is merely to raise seedlings of existing races, then seeds should be saved from cross-fertilised, modern, hardy varieties now annually sent out by the Messrs Waterers, Messrs Lane, and others. If early-blooming varieties are desired, then *R. caucasicum* is one of the best species to start with, or some of its varieties, as *R. Nobleanum* or *R. Nobleanum album.* We yet hope to see some new greenhouse varieties raised between the tubular-flowered species of which *R. jasminiflorum* is the type, and the hardy varieties of Rhododendron, *Azalea sinensis*, or the Ghent Azaleas.

The late Mr John Standish was one of the first who attempted to improve the hardy Rhododendrons by hybridising them with the Indian species; and he appears to have gone to work in the gardens of the Duchess of Gloucester at Bagshot Park, soon after the introduction of *R. arboreum*, for one of his first hybrids was *R. altaclarense* (*R. arboreum* × *R. catawbiense*). Then came *R. Blandyanum* (*R. catawbiense* × *R. altaclarense*), and *R. Blandyanum superbum* was the result of crossing *R. Blandyanum* with pollen from a variety named "Queen Victoria," other seedlings from this last-named cross being *Manglesii*, "Robert Burns," *Menziesii*, "Countess de Morella," "General Cabrera," and others.

Another race was produced by using *R. maximum*, another North American species, as the seed-parent, this also being fertilised by pollen of the Indian *R. arboreum.* One of the first products of this cross was *R. Lindsayii;* and this variety, fertilised with pollen from *R. ponticum album*, produced a numerous progeny, whose flowers varied from white through all the shades of lilac to a deep purple. These being again crossed

with the previous hybrid variety *R. altaclarense*, gave a beautiful lot of varieties, among which were *Paxtonii*, "Mrs Beecher Stowe," "Gem," and several others; and *Paxtonii*, fertilised by *Lindsayii*, gave "Climax," *Fimbriatum*, and others.

A third series of varieties was originated by crossing *R. ponticum purpureum* with *R. altaclarense*. One of the best of these was "Queen Victoria," which in its turn was fertilised with *R. altaclarense*, and produced "Vesuvius;" and the last-named again, crossed with *R. Blandyanum*, gave *Brebnerii*, "Madame Titiens," and many other fine forms.

R. maximum, crossed by *R. caucasicum*, produced "Cunningham's White;" and the last, with *Blandyanum*, produced *limbatum*, one of the most beautiful of all the forms then known.

From the hybrids of the *R. catawbiense* section—for example, *album elegans*, *pictum*, and others—such fine forms as "Standish's Perfection," "Minnie," "Mrs Standish," and others, were produced.

In the 'Journal of the Royal Horticultural Society,' vol. v. p. 271, Messrs Standish & Noble thus relate their experience in raising hybrid Rhododendrons:—

"We find that, analogous to what is observed in the animal kingdom, the greater the cross the more healthy the progeny, and that breeding 'in and in' produces weak and deteriorated constitutions. We have a remarkable instance of this in a batch of hybrids, raised from *Caucasicum album* (that being a hybrid), fertilised by its own pollen. The plants are extremely dwarf, with variegated foliage. So dwarf are they that many of them had eight or ten flower-buds on, when only from four to six inches high, and four years old. They, however, bloomed quite freely when only three years old, and about as many inches high. Flowers produced by these dwarfs were again fertilised by their own farina, and although seeds were produced and vegetated, the plants could not be kept alive, but after various durations of existence, from two to eighteen months, they finally disappeared. One of the dwarfs above-named, which we have called Bride, fertilised with the pollen from another distinct hybrid, has, however, produced some very healthy seedlings. A remarkable example of the varied nature which hybridising effects in the Rhododendron is afforded in a hybrid raised from *R. catawbiense* by a large yellow Ghent Azalea. The object was to raise a hardy yellow hybrid, but in this we have been disappointed, as it has proved to be pink, and we have named it "Deception." It is an extraordinary cross; we never recollect meeting with so decided a 'sport.' It resembles neither of its parents, being one of our best growers,

with foliage large and thick, of a bright green, and when in a young state it has the appearance of being coated with varnish. Another remarkable hybrid, which we have called Towardii, was raised from *Catawbiense* by *Altaclarense*, this being a perfect giant in every respect. The foliage is very fine, and the flowers, both individually and in the truss, remarkably large, each forming a perfect cup. We know no Rhododendron equal to it in size and perfection of flowers.

"Having shown some of the effects of hybridising upon the Rhododendron, and the various breeds produced, we would beg to recommend all who intend practising this very interesting branch of horticulture, no matter what class of plants they propose to operate on, to choose the parents, whether species or hybrids, as far removed from each other as is consistent with the constitution of the plants and the result aimed at. We have in a tabular form appended a description of eight distinct sections of hybrid Rhododendrons, and it will be seen that all our third crosses, although all hybrids, have been selected as distinct from each other as possible. The plants raised from these crosses are all as healthy as we could wish, and they present a very great diversity in the characters of their foliage.

* SLCTION I.

Catawbiense Arboreum	*Altaclarense*	Catawbiense Altaclarense	*Blandyanum.* *Towardii.* *Meteor.* *Elegans.* *Nobleanum bicolor.* *Pulchellum.*

SECTION II.

Ponticum Maximum	*Hybrid Maximum*	Hybrid Maximum Altaclarense	*Standishii.* *Mrs Loudon.* *Picturatum.* *Vivid.* *Captivation.* *Raeanum.*

SECTION III.

Ponticum album Caucasicum	*Caucasicum album*	Caucasicum album, fertilised by its own farina	*Bride.* *Original*, and a race of remarkable dwarf and variegated varieties.

* When the name in this arrangement in printed in ordinary type, it indicates the plant to have been a breeder; when in italics, a hybrid produced. Thus, Catawbiense, fertilised with pollen of Arboreum, produced Altaclarense. Then taking Catawbiense as the female again, and fertilising it with the pollen of the hybrid Altaclarense, a race of excellent flowers, such as Blandyanum, Towardii, &c., was produced.

Section IV.		Section V.	
Purpureum Altaclarense	*Queen Victoria.*	Caucasicum Arboreum album	*Coriaceum.*

Section VI.		Section VII.	
Catawbiense Large yellow Ghent Azalea	*Deception.*	Campanulatum Hybrid Maximum	*Hybrid Campanulatum.*

Section VIII.	
Bride Dried farina (pollen) of Dalhousieanum	Result not known."

Mr J. Anderson-Henry has drawn attention to the apparently partial hybridity which takes places in Veronicas (see Veronica), and the non-reciprocity of the hybrid union between certain species of Rhododendron (see 'Jour. Royal Hort. Soc.,' 1873, p. 105 :—

"I have no doubt something of the same kind occurs among Rhododendrons. But I may only instance one case where I crossed *R. Edgworthii* on *R. caucasicum ;* the seedlings, ever few when the cross is a severe one (by which term I mean such instances as where the species do not affect each other kindly), were only two in number; and though now about ten years old, they show no indications of setting for flower. But while they have both the glabrous foliage of the seed-bearer, and even the ochreous tint underneath, they differ in having pyriform instead of its lanceolate leaves. But though in these particulars they depart from the normal state of *R. caucasicum*, they have not one feature of *R. Edgworthii*, the male parent. The other case is where I crossed the same *R. Edgworthii* on *R. Jenkinsii.* Here the seedlings, again only two in number, resembled the mother, except in having again the pyriform foliage, in which, be it observed, it is a departure from both parents, both having lanceolate leaves, those of *R. Jenkinsii* being acutely so. The hybrid in this latter case is budded for flower; but the flowers of both parents are white, and both sweet-scented, and among the largest of the genus, though the scent, texture, and forms of the flowers are different; so that I look for surer tests in the coming flowers, though these may be more perplexing too than any that yet appears. It is proper to observe that I take the utmost precaution in all my crossing operations to prevent miscarriage in any possible way.

"While treating of my difficulties with this *R. Edgworthii*,

one of the most peculiarly constituted as it is one of the most peculiarly featured of all the Rhododendron tribe, having its rugose leaves densely pubescent on the upper while it is perfectly shaggy with tomentum on the under side, every stem being clothed with the same tomentum, I have another most singular peculiarity to note in regard to it—namely, that while it will cross other species, it will take on a cross from none,—that is to say, while it has been repeatedly made the male, it has never with me, though I have tried it often, nor with any other that I have heard of, submitted to become the female parent. I have crossed it repeatedly on *R. ciliatum*, one of the minor forms, too, of Dr Hooker's Himalayan species. It has been crossed, too, on *R. formosum* in this neighbourhood, I believe, in the Stanwell Nursery; but I never could get it to take on any cross whatever. *R. Nuttalli* behaved, with me, in the same manner; it would cross, but not be crossed: but I did not persevere with it as I did with *R. Edgworthii.* Now I do not assert absolutely that *R. Edgworthii*, in the numerous tribe of which it is a member, may not be hybridised with some other of its kindred, but I could never get it to reciprocate a cross. And this remarkable circumstance of non-reciprocity has perplexed and defied me in innumerable instances throughout my long experience in these pursuits. It occurred to me that the pollen of larger forms might be of larger grains, and so might not pass through the necessarily small ducts of the styles of smaller species; yet *R. ciliatum*, a tiny species of one foot high, was crossed freely by *R. Edgworthii*, as I have just noticed, a species of six feet high. I even crossed this latter species on a pure Indian Azalea, though, by pulling the seed-pod before it was ripe, I raised no seeds of this latter cross."

The same gentleman, writing to the 'Gardeners' Chronicle,' remarks: "I have raised no end of another brood obtained by crossing *Rhododendron Nuttalli* on another hybrid of my own obtained by crossing *R. formosum* and *R. Dalhousieanum.*"

On the Continent, among the first to hybridise the Rhododendron were MM. Lemichez, who went to work with *R. catawbiense*, *R. maximum*, *R. caucasicum*, and *R. arboreum.*

Rhododendron Rovellii.—A small-growing hardy hybrid raised in Italy by M. Rovelli. It is the result of a cross effected between *R. dauricum* and *R. arboreum*, and is said to combine the early-blooming habit of the former with the vigour and glowing beauty of the latter species (see 'Revue Hort.,' 1867, p. 159; Herbert's 'Amaryllidaceæ,' p. 359).

The following short list of early Rhododendron hybrids, with

their parentage, will be interesting to those who wish to see the relative influence of the male or female parents :—

R. Nobleanum.—Female, Caucasicum ; male, Arboreum.
R. Altaclarense.—Female, Catawbiense ; male, Arboreum.
R. Russellianum.—Female, Catawbiense, var. ; male, Arboreum.
R. Nobleanum album.—Female, Caucasicum ; male, Cinnamonicum.
R. coriacea.—Female, Caucasicum ; male, Catawbiense.
R. '*Cunningham's White.*'—Female, Maximum ; male, Caucasicum.

The beautiful hybrids obtained by the hybridists aroused the energy of other cultivators ; and Mr Smith of Norbiton, near Kingston, succeeded in fertilising *R. ponticum* with pollen from *Azalea sinensis*, the result being a beautiful race of hybrid varieties, of which we may name *R. aureum* (see Paxt. 'Mag. of Bot.,' vol. ix. p. 79), *decorum*, *amœnum*, *carneum*, *flavescens*, *norbitonense*, and *elegantissimum*. Of these, the best—or one of the best—was *aureum*, which seems to be now very rare, as I remember a gentleman asking in the gardening journals in 1874 for information as to where he could get a plant of "Smith's Aureum" without any response. These hybrids were raised about 1836, and five of the most distinct (including the first variety obtained—viz., *R. norbitonense*) were exhibited in Ghent in 1839. In 1844, another series of these beautiful hybrids was obtained, among which were *R. aureum superbum*, *Burlingtonii*, *Broughtonianum*, *cupreum elegans*, *Jenkinsonii*, *ochroleucum*, *spectabile grandiflorum*, and "Victoria Regina."—(See Herbert's 'Amaryllidaceæ,' p. 356 and 359, for other interesting hybrids of Rhododendron Azalea, &c.)

R. præcox (see 'Revue Hort.,' 1868, p. 211) is an exceedingly floriferous rosy-flowered hybrid between *R. ciliatum* and *R. dahuricum*, and being an early-flowering plant it deserves the attention of the hybridiser. Crossed with other early forms which bear forcing well, such as *R. Nobleanum*, we might obtain an early-flowered and valuable race of varieties of great value for pot-culture indoors; and with the help of Messrs Veitch's hybrids of the greenhouse section, we may girdle the year with Rhododendrons as well as with Roses.

Figures of the earlier species of Rhododendron are given in the 'Botanical Magazine:' *R. catawbiense*, t. 1671 ; *R. ponticum*, t. 650 ; *R. maximum*, t. 951. The flowers of the last-named species are light rosy pink and white, like apple-blossom.

R. caucasicum is a white-flowered species, having green spots on the upper petals and suffused with rose behind. The leaves are deep green above and rufous below (see 'Bot. Mag.,' t. 1145).

Apart from the hardy kinds, there is a very beautiful race of warm greenhouse species, among which we may name the following as excellent types for the hybridist to work upon: *R. arboreum* (crimson), *R. argenteum* (white), *R. Brookei flavum* (orange yellow), *R. fulgens* (crimson scarlet), *R. jasminiflorum* (with clusters of pure white Stephanotis-like flowers), *R. javanicum* (orange scarlet), *R. tubiflorum* (crimson or reddish-purple flowers, very curious), *R. retusum* (reddish-orange flowers in terminal clusters), *R. virgatum* (flowers rosy white, the only species bearing axillary flowers). One of the finest and earliest hybrids in this group was obtained by Mr Lees, gardener to the Earl of Haddington at Tynningham. This is "Countess of Haddington," a large white-flowered fragrant variety, the result of a cross effected between *R. Edgworthii* and *R. Gibsonii*. Another hybrid, *R. multiflorum*, was obtained by Mr Davis, of Liverpool, by crossing *R. ciliatum*, a beautiful hardy or half-hardy species from the Himalayas, with *R. virgatum*. Another in the same class, R. "Duchess of Buccleuch," was raised by Mr Fraser in the Leith Walk Nurseries, Edinburgh, this being a cross between *R. Edgworthii* and *R. Gibsonii*. "Prince of Wales" (Rollison) is the result of crossing *R. javanicum* with *R. retusum*, and has clusters of bright reddish-orange flowers. "Princess of Wales," "Princess Alice," "Princess Helena," and "Princess Mary," are also lovely white or rosy-white varieties, the last named having been raised by Messrs Rollison, and is curious, as its clusters of flowers are coloured like apple-blossoms. It is worth while noting that Rhododendrons vary more when crossed in the second generation—that is to say, crosses between the hybrid and cross-bred varieties vary more in colour and habit, and are more floriferous, than is the case of the seedlings obtained between two species. There can be little doubt but that these plants become crossed by insects freely in their native habitats. That the bees visit these flowers we know from the ancient account, which states that the Pontic honey which stupefied the Greek soldiers was collected from *R. ponticum*, while other historians give *Azalea pontica* as the plant. The pretty little Austrian *R. chamæcistus* (see 'Bot. Mag.,' t. 488) has been crossed with the Scotch Menziesia, while Mr Anderson-Henry believes he has crossed it with *R. virgatum*, a distinct species known by its axillary flowers. The flowers of this plant (*R. chamæcistus*) resemble those of a Kalmia in size and colour.

Rhododendron hybrids of great beauty have been raised by Messrs Veitch between *R. javanicum* and *R. jasminiflorum*, one of the best being R. "Princess Royal," which has again been

most successfully used in crossing with *R. Lobbii*. These crosses grow well in a warm greenhouse temperature, and flower freely, their elegant clusters of bright rose, white, salmon, or scarlet flowers being agreeably odorous. R. "Duchess of Edinburgh," raised from R. "Princess Royal" and *R. Lobbii*, is a vivid scarlet variety, and one of the finest in the class (see 'Florist,' 1874, p. 145, for coloured figure and description).

HYBRID GREENHOUSE RHODODENDRONS.

PROGENY.	PARENTS.		
* R. Princess Royal,............	R. javanicum	×	R. jasminiflorum.
R. Princess Alice,....	R. Edgeworthii	×	R. ciliatum.
R. Princess Alexandra,.......	R. Princess Royal	×	R. Brookei.
R. Princess Helena,..........	R. Lobbii	×	R. jasminiflorum.
R. Princess of Wales,.......	R. Lobbii	×	R. Princess Royal.
R. Princess Thyra, ...	R. Brookei gracilis	×	R. Princess Helena.
R. Crown - Princess of Prussia, ...	Do.	×	Do.
R. Duchess of Teck, ...	R. Lobbii	×	R. Princess Royal.
R. Duchess of Edinburgh,...	Do.	×	Do.
R. Prince Leopold......	Do.	×	Do.

Bryanthus.—*B. erectus* is one of the most beautiful of all dwarf hardy shrubs, and is a hybrid raised by the late Mr James Cunningham, of the Comely Bank Nurseries, Edinburgh. It is the result of a cross between *Menziesia cærulea* and *Rhododendron chamæcistus*, and most nearly resembles the first-named plant. Apart altogether from its beauty, however, this plant is of peculiar interest to the hybridiser as being a true bigeneric hybrid.

THE EPACRIS FAMILY (*Epacridaceæ*).

Epacris.—A genus of showy, free-flowering, erect-growing greenhouse shrubs from Australia, similar in general habit of growth and mode of flowering to Ericas, but differing in points of structure and geographical distribution. They are readily propagated by cuttings of the young growth inserted in well-drained pots surfaced with sand, as recommended for Ericas. In some cases it will be necessary to place the plants in heat to obtain cuttings, as is also the case with slow-growing Heaths. Nearly all the kinds in cultivation are hybrids or seminal varie-

* It is interesting to find that Mr W. W. Buller also obtained a hybrid very similar to this, and from precisely the same parents, and this plant was exhibited at South Kensington on March 6, 1866 (see Jour. 'Royal Hort. Soc.,' 1866, p. 31).

ties, and the following species may serve for parents in obtaining hybrids: *E. attenuata elegans*, *lævigata*, *coccinea*, *campanulata*, *refulgens*, and *impressa*. They do not seed freely unless carefully fertilised and in a vigorous state of health. Seeds should be sown as soon as they are gathered (see Erica).

About 1844-45, several beautiful hybrids were raised by English nurserymen between *Epacris impressa* and *E. grandiflora*.

The Spurge Family (*Euphorbiaceæ*).

Euphorbia.—A genus of highly variable plants represented in our flora by several annual weeds. The decussate glaucous-leaved *E. lathyrus* is popularly but erroneously called the Caper plant, and its seeds are used as a substitute for real Capers, or fruit of *Capparis spinosa*. The annuals and herbaceous species are readily propagated by seeds or division. The strong-growing African species are often grown in collections of succulent plants; and *E. Bojerii*, *E. splendens*, and *E.* (*jaquinæflora*) *fulgens* are cultivated for their glowing scarlet flowers. A dwarf-growing variety of the last-named plant would be invaluable for cut flowers or decorative purposes; or it might be possible to obtain hybrids between that species and *E. splendens*, or others of a more sturdy habit of growth. The three last named are all easily multiplied by cuttings in a moderately dry heat; and the succulent species are easily propagated by offsets or cuttings of the branches inserted in sandy soil, and placed on a dry sunny shelf near the light. Seed is sometimes produced by the succulent species, and germinates readily sown in a gentle bottom-heat; but the seedlings should be set in a dry sunny position as soon as they appear above the soil, otherwise they are apt to damp off. I believe nothing has yet been done in the way of hybridising these plants, and there is a good field open, as crosses between some of the following genera might possibly be effected. The dwarf-growing kinds—such as *E. globosa*, *E. meloformis*, *E. caput-Medusæ*, and others—may be grafted on the strong-growing columnar or candelabra-like species, as *E. canariensis*, *E. cærulescens*, *E. erosa*, *E. polygona*, or the slender-growing *E. mammillaris*. *E. punicea* is an old erect-growing plant, bearing bright green leaves, among which scarlet bracts are produced near the apex similar to those of *Poinsettia*, but smaller.

Buxus (*Box*).—A genus of shrubs or small trees represented in our gardens by *B. sempervirens* or Common Box, and its numerous forms. There are gold and silver variegated forms,

and in the gardens at Shrubland there is a distinct variety with drooping branches, "as pendulous as those of a weeping Ash." Another very ornate decorative form is the Hardwicke Box, a very fine evergreen shrub, much like the Handsworth Box in general character. Mr Fish says that the original plant is at Hardwicke, and looks to be about twenty or more years old. "Lady Cullum," he writes, "tells me that it came up amongst others, and Sir Thomas Cullum, who was a great admirer of Box, thought, I believe, that it was a cross between the Minorca and the Common Box. There seems no doubt it originated here, and all our stock is the produce of one plant. It is most distinct and beautiful. All the other kinds of Box seed very freely here, but I have never seen the Hardwicke variety either flower or seed, which is somewhat singular. We have thousands come up in the shubberies every year, but I have not seen one at all like the Hardwicke."

The dwarf Box used for edgings to walks and flower-beds is *B. sempervirens suffruticosa.* In the north of Europe *B. sempervirens* attains a height of 20 to 30 feet, and the wood, which is annually becoming more expensive, is imported largely for the manufacture of blocks for engraving purposes, and also for mathematical instruments, more especially for folding carpenters' rules. All the finer kinds of wood-engraving are executed on blocks of this wood cut into squares exactly one inch in thickness. The engravings in this work are all cut on this wood, which is sold at prices varying from one halfpenny to sixpence per square inch, according to quality and size. *B. balearica* or Minorca Box has larger leaves than the common species, and is not so hardy. All the kinds may be propagated from seeds sown as soon as ripe, or from cuttings five or six inches in length taken from the current year's growth about August, and inserted in rows like Laurel cuttings along a sheltered border having a northern aspect. *B. australis*, a New Holland species, and *B. chinensis* (Chinese), require a greenhouse temperature in winter. *B. Fortunii* (China) and *B. longifolia* (Nepal) are distinct (see 'Revue Horticole,' 1871, p. 519, 520).

Dalechampia.—A small genus of Asiatic or Indian plants, *D. Rozleana rosea* being sometimes met with in gardens. It has glossy drooping or lanceolate-serrate leaves, and yellow flowers, protected by large heart-shaped pink bracts; easily propagated by cuttings of the young growth. One or two elegant scandent Indian species are yet unintroduced.

Codiæum (*Crotons*).—A well-known genus of ornamental-foliaged stove shrubs, natives of the Moluccas and the South

Sea Islands. Their flowers are green and inconspicuous, being borne on different spikes or racemes on the same plant (monœcious). The male flowers are small, with numerous stamens; while the female flowers have no petals, but bear a three-celled ovary or seed-vessel, having a three-lobed style, and each cell of the ovary contains a single seed, as in many other Spurgeworts. They are readily propagated by cuttings of the young growth inserted in light sandy soil, and placed on a genial bottom-heat in a close case, where the temperature varies from 75° to 80°. Most of the varieties—variable as they undoubtedly are—may be referred to *C. pictum;* indeed, only two other species are known. In the Moluccas this plant is grown as a decorative shrub, and made into fences, much as Box is used here at home; while in the South Sea Islands numerous seminal varieties are found. Some of the most distinct of these were introduced about ten years ago by the late Mr John Gould Veitch, and since the introduction of these others have been imported, and many seminal varieties have originated in the London nurseries, others having been originated by sports. These varieties vary immensely from seed, scarcely two plants coming exactly alike; and seed is very freely borne on well-grown plants, if due precautions are taken to fertilise the female flowers with pollen from the males, the only difficulty being to obtain male flowers when the female ones are open. If the female flowers are fertilised by pollen from a distinct variety, some very good results may be expected. The seeds should be sown as soon as they are gathered, in a well-drained pot or pan, in light sandy compost, and placed in a bottom-heated case where the temperature is 70° to 80°. Germination soon takes place; and as the plants grow very quickly—seedlings even faster than cuttings—the hybridiser has not long to wait for results. Careful cross-fertilisation is always to be recommended, even in the case of the most sportive of all plants, such as Calceolarias or Mimulus; yet seeds of Crotons often give many new forms when fertilised with pollen from the same variety: indeed they are as variable in this respect as the variegated Dracænas or Caladiums.

Croton Bellulum is a seedling from *C. cornutum*, crossed with pollen from *C. Weismannianum*.

C. Andreanum is a seedling from *C. maximum*, fecundated with pollen from *C. Veitchii* (see 'L'Illustration Horticole,' 1875, pl. 201 and pl. 210).

It is simply impossible to attempt to give the parentage of all the cross-bred varieties which have been raised in our own

and Continental nurseries, but all the varieties have descended from the old *C. pictum*, and its descendants promise to be as numerous as those of the Potato or Cabbage.

Poinsettia.—*P. pulcherrima* is one of the most striking of all ornamental winter-flowering plants, its beauty principally consisting in the brilliant scarlet bracts which form a radiate crown around the somewhat inconspicuous greenish-yellow flowers. There is a variety having creamy-white bracts; and Messrs Veitch and Mr Bull have raised seminal varieties differing in colour and shape of the bracts.

P. pulcherrima major (Veitch) has broader and smoother bracts than those of the type, and is fully a fortnight or three weeks earlier.

P. pulcherrima roseá carminata (Bull).—The bracts of this variety are of a distinct rosy carmine hue, and broader and flatter than in the type, so that a rounder and fuller head is formed.

A monstrous variety, having a clustered head of small bracts, was introduced to this country from North American gardens by Messrs Veitch in 1875. This plant—evidently a variety of *P. pulcherrima*—was discovered by M. Roezl, in the gardens of a small Indian village in the Mexican State of Guerrero, in May 1873. The flower-heads were 14-18 inches across, and about 6 inches in height. The bracts are scarlet, tinged with violet, and last in perfection several weeks, or even months. The plant was sent by M. Roezl to Mr J. Buchanan of New York (see 'Garden,' vol. iv. p. 143).

All the varieties are readily increased in the spring months by cuttings of the young growth with a heel of old wood attached; or the last year's stems may be cut into separate eyes, as in the case of the Grape-vine, and inserted in a genial bottom-heat: these grow away readily. Some propagate this plant after the bracts make their appearance by taking off the tops and striking them in a moist genial bottom-heat in a close case, the principal object of this method—which is also practised with the Chrysanthemum and Gardenia—being to obtain dwarf plants in small pots for decorative purposes. The flowers are small and fleshy, and seed may be obtained by artificial fertilisation. A seminal or hybrid variety of dwarf shrubby habit is a desideratum we hope to see produced. A hybrid between *Poinsettia* and some of the showy-flowered Euphorbiads might possibly be obtained.

The Fern Family (*Filices*).

Well-known evergreen or deciduous plants, distributed over a large portion of the earth's surface, and deservedly much grown and admired in gardens. Most of the species are very readily propagated by brown dust-like bodies (*spores*), borne in little cases arranged in rows, dots, or lines, on the under surface of the frond (*leaf*). These spores are so light that they are blown about by the slightest breath of air, and come up like weeds in most Ferneries. There is considerable difference in the time occupied in germinating by spores of different genera or species. For example, *Gymnogramma*, *Pteris*, and *Aspleniums*, grow up freely in a few weeks after being sown; while *Trichomanes*, *Hymenophyllum*, *Marattias*, and others, do not grow very freely under any circumstances, and take months to germinate.

The spores should be gathered as soon as ripe, and either kept in dry paper until spring, or sown at once on the surface of well-drained pots, the pots being covered with a flat circular piece of glass, and placed in a moist propagating case or frame. If the seedlings come up too thickly, forming a layer of liverwort-like growth on the pot-tops, pans of moist sandy earth may be prepared, and pieces of the green growth taken up and pricked off, at about an inch apart, after which give a gentle watering, and return the pans into the case until the young growth becomes established. If the young growths (*prothallia*) are not pricked off in this way, the stronger choke the weaker, and so many plants are lost; and in the case of new or rare kinds this is, of course, to be avoided as much as possible. Some propagators cut the fertile fronds off the plants they wish to propagate, and lay them, spores downwards, on a pan of moist earth, securing them with bent twigs or little pegs. By adopting this plan, the frond may be cut and pegged down some little time before the spore-cases burst; for if this happens many of the spores are dispersed and lost. In the case of free-growing kinds, the plant may be set above a thin layer of old coal-ashes or sandy earth, and the spores allowed to fall naturally and germinate, after which they can be pricked off when in the intermediate stage, or left until the fronds appear, and they are large enough to be potted. Many *Aspleniums*, *Adiantums*, and *Osmunda orientalis*, are proliferous, and these are readily multiplied by cutting off the fronds and pegging them down, so as to enable the young plants to root; or in some cases they can be removed with a little bit of the frond,

and pricked off in pans. Many cespitose Ferns are readily propagated by division.

Hybridising.—It does not appear to be generally known that it is possible to cross-fertilise or hybridise Ferns, and possibly also other cryptogams. To explain how this is to be effected in the case of Ferns, we must begin with the seed or spore. A Fern-spore is a minute round body with two elastic coats, one within the other, and the hemispherical cavity inside the inner coat is filled with that peculiar living matter made familiar to us by Huxley and others under the name of protoplasm. When the spore falls upon a moist and suitable surface, it swells and protrudes two or three tube-like cells, one of which elongates and develops into other cells, until a green, flat, liverwort-like expansion is formed, called the *prothallus*, and familiar to every gardener who has sown Fern-spores, since their appearance indicates the growth he expected to call forth. Now we come to the interesting stage when fertilisation takes place. If the under side of a well-developed prothallus be examined under a good lens, a series of small, white, hair-like rootlets will be found protruding from it, while around its margin will be found one or more notches or indentations. Among the rootlets, however, are two series of cysts or cells of a more or less hemispherical shape, and both containing organs of a different nature. In one series of cysts or receptacles we find round, loose cells, not unlike the parent spore in general appearance, but of a more delicate texture. When these are fully developed, the cyst in which they have been generated becomes ruptured, and they fall or are projected out on the surface of the moist soil or prothallus. Now each of these little cells contains a small quantity of fluid, in which is confined a minute spiral body like a vinegar eel, but very much smaller; and as the cells soon burst in water, these little eel-like bodies are set free, and possess the power of moving with incredible velocity in water, while they are so minute that the most gentle dew on a leaf is sufficient to enable them to traverse it in all directions. These little bodies are called *antherozoids*, and possess a power analogous to that of pollen in flowering-plants. These eel-like bodies are common to different forms of cryptogamic or flowerless vegetation, and are the very agents which enable the Potato-disease (*Peronospora infestans*) to increase so rapidly when once it gains a footing. Careful examination of the liverwort-like prothallus towards its margins, however, reveals another series of cysts (*archegonia*), and these contain a proembryoic cavity at their base, which may be likened to the ovary in flowering-plants.

Now, if one or more of the male eel-like antherozoids in their movements come in contact with the cavity in the female cells, the result is a kind of fertilisation similar to that which takes place when pollen is wafted on to the stigma of flowering-plants; and as soon as this takes place, the young or embryo Fern begins its growth. Gardeners often look on the first growth or prothallus as analogous to the seed-leaves in flowering-plants; but this in reality is not the case, the prothallus representing, in fact, an intermediate generation in the life-history of the Fern. Another singular fact is, that the male organs only have as yet been detected in Osmunda, while other Ferns produce male and female organs at different periods, as if to facilitate intercrossing. As a practical deduction from the above facts, it has been suggested that a clever and careful manipulator might be able to produce hybrid Ferns by removing the antherozoids by means of a drop of water on the hair-like point of a sable brush, and applying them to the archegonia or female ovary-like cells of another species. In some cases this result is believed to have been effected accidentally in nature, especially amongst Gymnogrammas; and a supposed natural hybrid between *Pteris serrulata* and *Pteris tremula* made its appearance in a batch of young Ferns raised at Chiswick a year or two ago. (See 'Jour. Royal Hort. Society' (new series), vol. i. p. 137, for a very interesting account of a supposed hybrid Fern, and remarks on artificial fertilisation. In the 'Trans. Linn. Soc.,' vol. ii. p. 93, is an interesting account of the germination of Fern-spores, &c. See also vol. xxi. p. 117.)

Many practical propagators have been surprised at the results which have attended their attempts to propagate particular kinds of Ferns from spores, owing to the appearance of other species in the pots or pans in which spores of any particular variety had been sown. M. Mayer of Carlsruhe has made many experiments on the germination of Ferns, and points out that boiling or baking the soil for some time in order to kill the germs of Ferns, Liverworts, &c., is essential, using the soil directly afterwards, and covering it from the atmosphere with an inverted shade or bell-glass, so as to exclude the spores of such genera as Pteris, Gymnogramma, Liverworts, or Confervæ, which, being exceedingly fertile, choke up any of the more delicate kinds. Spores should always be sown in a house or pit from which all spore-bearing Ferns are excluded; for unless this is done, it is next to impossible to prevent free-growing intruders, or "rogues," taking possession of the pots. Care should be taken to gather spores before the cases burst for it is no unusual thing for the empty spore-

cases to be sown carefully, and then the cultivator's hopes of raising a stock of any particular kind are doomed to disappointment. M. Mayer has succeeded in raising *Gleichenia cicarpa* and *Marattia latifolia* from spores. The *Gleichenia* he succeeded in raising in large numbers, but the process is slow, a period of five months intervening between the appearance of the prothallium frond and the development of the first young frond-spores. *Marattia latifolia* produced prothallia a month after sowing, and in another month they were sufficiently advanced to be pricked off in pans, and in a further period of six to eight months the first young fronds made their appearance. Every attempt to propagate any of the Hymenophyllaceæ from spores failed. In the last-named group the germination of the spores takes place before they are detached from the spore-cases, and the least check to their vegetation is fatal. Some of the more robust and fertile Ferns, on the other hand, produce spores which will germinate when taken from dried herbarium specimens twenty years old.

With respect to the supposed hybrid Ferns we can say but little, since up to the present time we have no positive evidence of their production. *Asplenium ebenoides* is supposed to be a natural hybrid between *A. ebeneum* × *Camptosarus rhizophyllus* (see 'Jour. Hort. Soc.,' vol. i. new series, p. 137, with figures). It is of N. American origin, having been found growing wild on the banks of the Schuylkill, about eight miles from Philadelphia, by Mr R. Robinson Scott of the latter place.

Pteris versicolor, *P. quadriaurita*, var. *argyrea*, and *P. cretica albo-lineata*, are probably spore-sports, as also are the numerous crested, depauperated, or furcate forms of *Athyrium*, *Lastrea*, *Scolopendrium*, *Pteris*, *Gymnogramma*, and other genera. Some seedling forms of *Lomaria gibba* are much larger and more vigorous than the typical species; and it has been suggested that they are hybrids between the last-named plant and *Blechnum braziliense*, or its variety *B. b. corcovadense*.

A plant of Pteris (*P. serrulato-tremula*) originated quite accidentally at Chiswick a few years ago, and is believed to be a hybrid between *P. tremula* and *P. serrulata*, itself one of the most variable of species when propagated from spores (see 'Jour. Royal Hort. Soc.,' vol. iv. new series, p. 38, fig. v.)

Todea intermedia is a wild intermediate form which combines the characters of *T. pellucida* and *T. superba*. Mr Thos. Moore, F.L.S., thus alludes to the variations or spore-sports of *Lomaria* in the 'Florist:' "*Lomaria gibba crispa* is a sport raised by Mrs E. Cole & Sons, which is of dwarfish habit, and so densely leafy and wavy that the edges of the pinna take on a

decidedly crisped appearance. Another variety of the same species, called *major*, has been raised in several places. It is very much larger in its growth than the true *L. gibba*, produces many fertile fronds as broadly leafy as those of a true Blechnum, those occupying the position of the normal fertile fronds being also less contracted than in the type: the plants, indeed, appear intermediate between *L. gibba* and *Blechnum braziliense.* These varieties are quite distinct from the finely ramose and crested *L. gibba Bellii*, grown by Messrs Osborn, and Messrs Veitch & Sons.

To what course of circumstances can we attribute the extreme variety observable in our native *Lastreas*, *Athyriums*, *Polypodiums*, *Polystichums*, and *Scolopendriums*? Doubtless many of these crested and depauperate forms owe their origin to cultivation, but nevertheless hundreds of other variations equally curious are found in the lanes and hedgerows of Devon and Cornwall, or on the Welsh mountains, so that we must look to a deeper disturbing cause than culture if we wish to know the truth as to the variability and want of fixity of character exhibited by these elegant cryptogams.

Mr Thos. Moore, F.L.S., writing of Gymnogrammas, says: "The Gold and Silver Ferns seem liable to a great amount of variation; and intermediate forms, whether hybrids or sports, are often very distinct and beautiful. Such is the case with some that M. Stelzner, of Ghent, has sent us. The most striking is *G. Laucheana gigantea*, a richly-powdered form of the *chrysophylla* group, growing to a large size, and having remarkably broad leafy pinnules: this will be found an extremely decorative plant. *G. aurea pendula cristata* has the same free-growing habit as the former, but with a multifid apex to the somewhat narrower fronds, and is of freer growth than most of the crested varieties of Gold Ferns. *G. Stelzneri superba cristata* is another Golden Fern more sparsely powdered, but very distinct and elegant: it has a multifidly-forked apex, the tips of the pinnæ broadly fingered, and the pinnules also broad." *G. Wettenhalliana* is another crested Gold Fern common in English gardens about 1867-68, and it was one of the first crested forms in cultivation.

A. elegantissimum (*hort. Williams*) and *A. Farleyense* (*ex hort.* Farley Hill, Barbadoes) are both supposed to be spore-sports or spore-hybrids, the first-named from *A. cuneatum*, and the latter from *A. scutum*. *A. Luddemannianum* (*hort. Veitch*) is a curious fasciated sport from the British Maiden-hair, *A. capillus-veneris*.

Asplenium Breynii is considered from its habit, &c., to be

a hybrid between *A. ruta muraria* and *A. septentrionale. Gymnogramma Martensii* originated in French gardens, and was afterwards found in Guadaloupe. Of course it is possible that spores may have been accidentally introduced from its native habitat, but in appearance it is intermediate between *G. calomelanos* and *G. chrysophylla.*

One of the earliest references to hybrid Ferns I have seen is in the 'Gardeners' Chronicle,' 1844, p. 500, and is a translation by the Rev. M. T. Berkeley of a paper by E. Regel which appeared in the 'Botanische Zeitung,' 1843. From the gardens of Bonn and Berlin, M. Regel had eight seemingly hybrid forms, all Gymnogrammas, as follows:—

G. L'Herminieri, between *G. chrysophylla* and *G. peruviana.*
G. chrysophyllo-distans, raised both at Erfurt and Berlin.
G. Martensii, between *G. chrysophylla* and *G. dealbata.*
G. Massonii, between *G. chrysophylla* and *G. calomelanos.*
G. chrysophyllo-melana, between the same species.
G. distanti-dealbata, between *G. distans* and *G. calomelanos.*
G. calomelanos-dealbata, between the species whose united names it bears.
G. distanti-calomelanos, between *G. distans* and *G. calomelanos.*

It does not appear to be generally known that *G. decomposita* accidentally made its appearance some years ago in Mr Gare's collection at Falkirk, N.B., and that it is presumably a spore-sport from *G. Pearcei.* Mr Henderson also describes several supposed hybrids or sports, these also belonging to the gold or silver dusted section of Gymnogramma. Whether these forms are really hybrids or not we have no means of ascertaining, although the truth from a scientific point of view would be very valuable. The fact, however, that many Ferns, especially Pteris and powdered Gymnogrammas, do vary when spores are sown in proximity, remains, and is of vast practical importance to the intelligent cultivator. One of the latest of novelties in this way is a beautiful Fern exactly like *Pteris serrulata cristata* in general habit, but there is also somewhat of the texture and variegation of *P. cretica albo-lineata.* Mr Meehan, in alluding to this variety (which originated as a spore-sport in America), says: "It is exactly intermediate" between the two varieties above named (see 'Amer. Gard.,' 1875, p. 330).

The Dielytra Family (*Fumariaceæ*).

A group of fleshy herbaceous plants, principally natives of temperate countries. The principal genera grown in gardens are *Dicentra, Dielytra, Adlumia, Corydalis,* and *Fumaria.*

Dielytra spectabilis is a very pretty hardy herbaceous plant from China, bearing white or rosy pink flowers. This plant and some species of *Corydalis* are the most showy, and are often met with in gardens. Lindley remarks that the economy of the sexual organs in Fumeworts is remarkable. "The stamens are in two parcels, the anthers of which are a little higher than the stigma. The two middle ones of these anthers are turned outwards, and do not appear to be capable of communicating their pollen to the stigma; the four lateral ones are also naturally turned outwards, but by a twist of their filament their face is presented to the stigma. They are all held firmly together by the cohesion of the tips of the flower, which, never unclosing, offer no apparent means of the pollen being disturbed so as to be shed upon the stigmatic surface. To remedy this inconvenience, the stigma is furnished with two blunt horns, one of which is inserted between and under the cells of the anthers of each parcel, so that without any alteration of position on the part of either organ, the mere contraction of the valves of the anthers is sufficient to shed the pollen upon that spot where it is required to perform the office of fecundation." Notwithstanding this seemingly admirable arrangement for securing self-impregnation, the fact is that very few fertile seeds are produced either by the species of *Dielytra* or *Corydalis;* and Mr J. Seden, after industriously applying pollen of several other allied species to the stigma of *Dielytra spectabilis*, failed to obtain a single seed. Is it possible that self-fertilisation for ages has destroyed the seminal fecundity of this *Dielytra?* or is fertilisation effected in its native habitats by insect agency?

The Mushroom Family (*Fungi*).*

The great family of Mushrooms, Toadstools, Mildew, and Moulds, many of the larger kinds being edible; but as yet little is known of their artificial propagation and culture. *Agaricus campestris* is the only kind cultivated in this country, and is well known as the Common Mushroom of fields and meadows. The Truffle (*Tuber cibarium*) is grown by artificial means in Prussia and Germany, but all attempts to cultivate it

* The reader interested in Mushroom-culture should see 'Mushroom-Culture,' by W. Robinson, F.L.S.; and 'Mushrooms, and how to Grow them,' by W. Earley. For an illustrated paper on "Reproduction in the Mushroom Tribe," by Mr W. G. Smith, F.L.S., the reader interested should see 'Gardeners' Chronicle,' 1875, p. 488-519.

in this country have failed. *Coprinus comatus* is often found on dunghills near stables, and is one of the best of the edible kinds; and *Agaricus procerus* (the Speckled or Parasol Agaric) is equal to the Common Mushroom, and is as well worth artificial culture as a food plant. Fungi, like Ferns, develop male and female organs, after the spore has commenced to germinate the zoospores, containing minute cilia—fringed bodies (*spermatozoids*)—which move rapidly in water, and act in a way analogous to pollen-grains by fertilising the germinal vesicle in the ovary-like cysts (*archegonia*). Many of the smaller Fungi are terrible pests, especially Mildew, which attacks Roses, Vines, Melons, Cucumbers, Peaches, and many other cultivated plants; and the *Peronospora infestans*, which works such sad havoc with our Potato crops in wet warm seasons. These the gardener seeks means to destroy rather than means to propagate. So far as edible Fungi are concerned, there is a field of labour open for all who can find time and opportunity to experimentalise on the artificial culture of Truffles and many Agarics which are equally as succulent, delicate in flavour, and nutritious as the Common Mushroom.

The great essentials to the development of the Common Mushroom are a moderate heat of 60° to 80°, accompanied by a humid atmosphere and a moderate amount of light. According to some authorities, they absorb a large amount of nitrogen; but the direct application of nitrogenic manures to the soil does not appear to influence their growth in the open ground. The Common or edible Mushroom is readily propagated from spawn—that is, cakes or bricks made of horse-dung, cow-dung, loam, and chopped hay well mixed together, and made into flat bricks; and to these cakes the mycelium of the Mushroom is added, either from a pasture where Mushrooms are found in abundance, or more often from previously made spawn. After the cobweb-like mycelium has spread through the compost in every direction, but before the more perfect silvery threads have time to form, the whole is formed into bricks or cakes, and dried; and curiously enough, the mycelium so treated retains its vitality for a long time, and soon develops itself when placed in a moist firm compost or bed of horse-droppings and soil, in a warm and humid atmosphere. The flat cakes are about 10 inches long by 5 wide, and vary from 1½ to 2 inches in thickness. By some spawn-cakes are made of cow-dung, horse-dung (that from horses at grass being best), sheep-dung, loam, and chopped hay, the latter being used to bind the whole firmly together. After these are made, they are laid on laths to become partially dry before the spawn is added. They are

then taken and placed in alternate rows of heated horse-droppings, and as each brick is added a hole or two is made in it with a pointed stick, and the cavity filled up with previously made and tested spawn. The bricks should not touch each other; and when a stack has been made, cover the whole with a layer of the heated droppings, which by gently heating the cakes causes them to be completely pervaded with mycelium. Spawn may be purchased from any seedsman, that known as the Milltrack or the French Spawn being considered the best. Tons of this esculent are grown in the caves or quarries which undermine Paris; and in this country they are largely grown in cellars, mushroom-houses, and by the London market-gardeners in open-air beds made in August, and covered with straw and mats. In Italy an edible species is cultivated by placing coffee-grounds in a cellar where a moderately genial temperature is kept up. This coffee-refuse soon becomes permeated by mycelium, and seems to furnish it with the requisite food for its full development.

Spawn may be made in a covered and dry, but not too airy, situation. The corner of a barn, or that of an out-house or shed, or even of a stable, are favourable places for its development. The bed in which it is to be generated should be made early in May, and the following are the materials employed, which may be reduced to smaller proportions, if necessary: fifty-six barrow-loads of fresh horse-dung, six barrow-loads of good garden soil, and one barrow-load of fresh wood-ashes, which have not been wet, with half a barrow-load of pigeon's-dung fresh from the pigeon-house: double the quantity of the latter must be used if it be of the preceding year. The whole should be watered lightly with cow's urine or water from the manure-heap. When the mixture has been properly made, after various turnings it should be placed to the depth of a foot along a wall: the width may be left out of the question, but it requires a certain bulk in order that it may heat gently. The bed must be trodden down firmly, and, at the end of ten days, the consolidating process must be repeated, and ought to be continued two or three times a-week until early in September. The manure, thus prepared, is cut with a sharp spade into squares of about a foot each. These are then left to dry in a granary, or any other airy place from which sunshine and, above all, damp are excluded. These bricks are placed on their sides, and turned from time to time. Spawn thus made will keep good from ten to twelve years, if it is placed in a dry position, free from frost. Sometimes, even in the granary in which the spawn is dried, large quantities of Mushrooms may

be gathered; they spring up amidst the *débris* accumulated along the wall, and even in the crannies between the boards of the floor.

The artificial propagation and intelligent culture of the species of Tuber or Truffles is well worth again attempting by horticulturists, notwithstanding that the experiments made by the Royal Horticultural Society a few years ago failed to produce any useful results. Mr Tillery succeeded in the artificial culture of Truffles at Welbeck some years ago, and thus relates his experience: "In 1843 I commenced here an experiment of trying to induce Truffles to grow in a young Oak plantation near the lake, by getting all the parings and overripe ones from the kitchen, and planting them in it. The soil of this Oak plantation had originally come from the bed of the lake, and was full of the shells of small fresh-water molluscs, so that it was of a calcareous nature. Wherever the old Truffles were planted I took great care that the Oak-leaves should not be disturbed in the autumn or winter, in order that they might form a frost-proof shelter for the young Truffles when growing. The first indication of the success of my venture was the fact of ripe Truffles being found in the places where the old ones had been planted, by the squirrels scenting them out and scratching them up to eat. I forwarded a fine specimen, weighing more than ½ lb. after having a piece cut off the top by the scythe of a mower, to the late Prof. Lindley, who pronounced it to be a veritable ripe Truffle. This plantation was afterwards protected and well attended to, and sometimes as many as from 2 lb. to 3 lb. of Truffles were dug up at a time, when wanted for the kitchen. In digging for them there was, however, a great loss, for many of the small unripe tubers were destroyed by the spade, from not having Truffle-dogs to scent out those only that were ripe. Afterwards, from alterations in the grounds, this Truffle-producing plantation was destroyed, and there was an end of the crop, for the ground they grew on was raised 4 ft. higher. Where young Oak plantations are growing on calcareous soils, there is therefore little doubt but that the artificial cultivation of Truffles may be successfully tried in this country." We have two or three British species, and if the conditions necessary to the development of these could be definitely ascertained and imitated in our gardens or plantations, a new food-producing branch of industry, and a most lucrative one, would be the result. Although Truffles are generally found in open Beech, Fir, or Oak woods, it seems to be a matter of doubt whether they are really parasitical on the roots of such trees, as has been

supposed: indeed, Mr C. E. Broome, an eminent authority, has decided that such is not the case, seeing that in Italy he had observed specimens dug from bare hillsides. Calcareous soils or calcareous clays on a cool bottom of marl or marly clay seem to suit the requirements of these Fungi best; while the reason of their being so often found under trees appears to be that the partial shade of overhanging branches prevents the soil drying too much, as is the case in more exposed positions. Truffles may be propagated by planting the tubers or portions of tubers which produce mycelium or spawn in suitable situations, analogous to that of Mushrooms. At Loudun, Poitou, and Bouardeline, a system of partial culture which may be described as an intelligent improvement of existing advantages, has proved highly remunerative, the production of Truffles on some lands otherwise worthless (except for timber) being worth from £10 to £20 per acre. Wiltshire and Hampshire are the two counties whence the principal home-grown supply is drawn for Covent Garden; and it is a singular fact that while on the chalk districts of Salisbury Plain, Truffles invariably appear on the ground being planted with Beech and Fir trees, no systematic attempts appear to have been made to propagate the best Continental summer and winter species, or even to augment the supply of our native kinds, by planting tubers at regular intervals apart, so as to increase the crop. The market value (retail) of Truffles varies from 2s. 6d. to 16s. per lb., according to the season and the variety, some being esteemed more highly by epicures than others. Those interested in Truffle-culture should read a valuable paper on "Truffles and Truffle-Culture," by C. E. Broome, Esq., in the 'Journal of the Royal Horticultural Society' (new series), p. 15-21; and "The Truffle, Oak, and Truffles," in the 'Garden,' vol. vii. p. 347. Valuable papers, also, by the Rev. M. J. Berkeley, will be found in the 'Gardeners' Chronicle,' 1845, p. 239 *et seq.*

THE GARRYA FAMILY (*Garryaceæ*).

This is one of the smallest of all natural orders, and was formerly referred to the Nettleworts. Nearly all the species are natives of North America; and *Garrya elliptica*—that is to say, the male form of it—is the best-known representative in our gardens. Layering is the most practicable method. *G. elliptica* was introduced from California in 1818 by Douglas; and it would be interesting to know if native-grown seeds or

female plants can be procured, this plant being one of the most beautiful of all evergreen hardy shrubs.

Garrya Thuretii (see 'Revue Hort.,' No. 1, 1869) is an hybrid plant raised from the seeds of *G. MacFaydiana* fertilised with pollen from *G. elliptica.* The seeds were saved in the late M. Thuret's garden at Antibes, and these were sown in 1863, the seedlings being planted out in the open air in 1864; and of the two plants raised, one is a female and the other a male, and both are vigorous. *G. elliptica* is a beautiful shrub, but rare in gardens—a circumstance partly owing to the absence of the female or seed-bearing plants, and partly to the difficulty which attends its propagation by cuttings. It has been suggested (see 'Revue Hort.,' 1870, p. 260) that seeds might be obtained by fertilising *G. macrophylla*, female plants of which are not uncommon, with pollen from *G. elliptica*, and in this way some new varieties might possibly be originated. Garryas may be propagated by layering in the autumn.

THE GENTIAN FAMILY (*Gentianaceæ*).

A widely-distributed group of very beautiful herbaceous or evergreen herbs, represented in our gardens by many European species. The most showy plants in the order are the Gentians, and one or two species of *Chironia* and *Erythræa.* The Gentians are found scattered on the mountains of both hemispheres, and are very interesting, since there are but few genera which vary so much in colour as does this, in which we find red, blue, yellow, white, orange, purple, lilac, and several other shades. *G. acaulis*, *G. verna*, *G. Andrewsii*, and others, are well known in our gardens. Gentians are readily propagated by division or by seeds, which should be sown as soon as ripe in pans of light moist earth, and placed in a cool frame. The seeds do not germinate freely if allowed to become hard and dry. Several kinds of Gentians are known to be natural hybrids; and *G. luteo-purpurea*, a hybrid between *G. lutea* and *G. purpurea*, was discovered on one of the mountains in Savoy by MM. Guillemin and Dumas as long ago as 1849.

THE CRANE'S-BILL FAMILY (*Geraniaceæ*).

A family of herbaceous plants and shrubs widely distributed, a large proportion being found at the Cape of Good Hope, these being chiefly species of *Pelargonium*; while the species of *Ero-*

dium (Storks'-bills) and *Geranium* are principally found in Europe, North America, and Northern Asia. The principal genera are *Pelargonium*, *Geranium*, *Erodium*, and *Monsonia*, the number of good species being, according to Lindley, about five hundred. It may be as well to state here that the genus *Pelargonium* consists of shrubby perennial plants, having irregular flowers, the two upper petals being largest; while *Geranium* is composed of herbaceous plants, with regular flowers, all the petals being equal. If a *Pelargonium* flower be examined, the spur which is free in the nearly-allied Tropæolums will here be found adnate to the pedicel of the flower, so as to be scarcely discernible. The seeds in this order are solitary and devoid of albumen, which distinguishes them from Oxalids, where the seeds are numerous in each carpel, and albuminous. The membranous stipules are a further character of the group. There are five distinct type-sections of *Pelargonium*:—

1. *P. grandiflorum* or *P. cucullatum*, types from which our large-flowered Show and Fancy or French Pelargoniums have originated.
2. *P. zonale* and *P. inquinans*, types from which scarlet Zonals, Nosegays, Tom Thumbs, Tricolors, Bronze Zonals, &c., have originated.
3. The tuberous or swollen-stemmed class, as *P. triste*, *P. oblongatum*, &c. (Much improvement may be worked in this section.)
4. The ivy-leaved group, represented by the descendants of *P. hederæfolium*, *P. peltatum*, or *P. lateripes*.
5. The cut-leaved, oak-leaved, or scented-leaved group, which will breed with Group No. 1, just as Group No. 4 and No. 2 may be blended by the hybridist. *P. quercifolium*, *P. glutinosum*, and *P. filicifolium* are types.

Pelargonium.*—A genus of shrubby-habited plants, popularly grown in gardens as Geraniums, and principally natives of the Cape of Good Hope; indeed, the Cape flora boasts of 170 species. Two are Australian, one or two natives of St Helena, and several others are found in northern and tropical Africa. Very few of these species are now generally grown in gardens. There are, however, many Cape species preserved at Kew; and Messrs E. G. Henderson and Sons cultivate about fifty of the more showy species, and also some of the early hybrid forms figured as species by Sweet in his 'Geraniaceæ' (a most interesting work on this genus, published in 1820-30), and by other authors. All who are interested in the history of the Pelargonium should see a paper contributed to the 'Gardeners' Chronicle,' 1875, p. 97-129, from which we learn that *P. zonale*

* See 'Pelargonium,' par Thibaut (Paris: 26 Rue Jacob); Sweet's 'Geraniaceæ;' and Andrews's 'Geraniums.' Many of the elegant old species as first introduced are figured in the earlier numbers of the 'Botanical Magazine.'

—the Zonal or Horse-shoe Pelargonium—is the earliest cultivated species (1710), and a white-margined seedling or sport soon followed, and is recorded in Miller's Dictionary, ed. 8, 1768. According to Sir Thomas More, in his 'Flower Garden Displayed,' this variety was grown at that date "in curious gardens," and is believed to have originated in Parisian gardens. Mr Grieve mentions Miller's Variegated as one of the earliest of variegated forms in cultivation. *P. Fothergillii* is one of the earliest improvements on *P. zonale*, and is figured by Andrews in his 'Geraniaceæ,' and he describes it as "the largest-flowered zone-leaved Geranium, first raised by the late Dr Fothergill about the year 1780." This plant was formerly much used in flower-garden arrangements, and is interesting as the starting-point or progenitor of the late Donald Beaton's Nosegay varieties. One of the next striking varieties was a gold-edged form of *P. zonale*, known in gardens as Golden Circle, and this was superseded in 1823 by Golden Chain, which differed mainly in having a broader and brighter golden margin to its green leaves. We have no records of the origin of these varieties; but they were possibly sports. *P. inquinans*, the original type of the Scarlet or Tom Thumb varieties, appears to have been first cultivated by Bishop Compton at Fulham in 1714. There is a remarkably strong-growing form of this species which used formerly to be much grown on greenhouse walls under the name of the Giant Tom Thumb. *P. inquinans* is figured by John Martyn in his 'Historia Plantorum Rariorum' (1728); and, according to Andrews, it had become scarce in its original form so early as 1809, so that it soon appears to have been used by the florist for hybridising with *P. zonale;* and these two species are the types whence our "bedding" varieties have been derived. The rosy-flowered variety known as Mangles's Variegated is supposed to have originated as a sport from *Fothergillii*. Previous to 1848, several white-margined varieties of one or both the above-named species were known and used in flower-garden arrangements, but their flowers were thin-petalled, and poor in form. About 1848-49, however, Mr Kinghorn raised a seedling of remarkable excellence, having broad white-margined leaves and scarlet broad-petalled flowers; and this, evidently a cross between some of the white-margined sports of *P. zonale* and the scarlet-flowered *P. inquinans*, was sent out by Messrs Lee, of Hammersmith, under the name of Flower of the Day. Numerous other forms followed, but nothing of striking importance until 1855, when Mr Peter Grieve raised the well-known Tricolor, Mrs Pollock, which still remains one of the best habited and most ornamental

This variety is the result of a cross between Golden Pheasant and Emperor of the French; a dark-zoned, scarlet-flowered kind, to which Mrs Pollock often reverts when grown in rich soil. Golden Pheasant was a cross between Emperor of the French and Golden Tom Thumb, the latter being itself a cross between Cottage Maid and Golden Chain. Messrs Grieve, Morris, Carter, Windebank, Shepherd, Smith, Henderson, Thorpe, Turner, Watson, and Gill, have also raised Tricolor varieties.

Soon after Mrs Pollock was sent out, Mr Wills originated another distinct group, the Bronze Zonals—his Beauty of Oulton being one of the earliest and best of the group; and this was followed by numerous other varieties raised by Messrs Wills, and Downie, Laird, & Laing. Twenty years or so before this, however, the late talented Donald Beaton, when gardener at Shrubland Park, had commenced to hybridise and raise seedling Pelargoniums, his aim being to improve the long-petalled forms of *P. zonale*, or the Nosegay forms, then represented by *Fothergillii*, and "Mangles's variegated." His seedlings were great improvements on their progenitors, and his Indian Yellow is still the nearest approach to a yellow "bedding" Pelargonium When Donald Beaton died, his stock of seedlings fell into the hands of Mr W. Paul, who has since sent out many good Nosegay forms, one of the best being Waltham Seedling. Among those who have, by careful cross-breeding, endeavoured to improve the flowers of the Zonal section, we may mention Messrs W. Paul, Pearson, Hibberd, Groom, Smith, and Denny, in England; while MM. Victor Lemoine and Jean Sisley have worked towards the same object and set the example in Continental gardens. Donald Beaton believed that he could produce a yellow-flowered Pelargonium, and some of our modern hybridists feel equally confident of producing a blue one; and one variety known as Amaranth, and a still more recent one named Mrs Turner, have a distinct blue shade, just as Beeton's Indian Yellow has a strong shade of yellow when seen in a mass.

About 1873 a novel variegated form made its appearance, under the name of *P.* "Happy Thought." Previous to this variety all our silver-variegated Zonals had leaves green in the centre, with a marginal band of silver. Here, however, the order of things is reversed, and we have a white leaf with a green margin. This plant bears bright lilac-carmine flowers, and promises to be the parent of a new and beautiful race. Its foliage sometimes reverts to that of the old *P. reticulatum*, which has a green leaf netted with fine gold lines; so we may

assume that to have been one of the parents crossed with one of the pink-flowered Zonals of the Christine type.

P. oblongatum (see 'Bot. Mag.,' t. 5996), a recently-introduced species, with thick fleshy stems, and clusters of yellow crimson-streaked flowers, has attracted the attention of hybridisers, who have attempted to infuse its yellow colour into the Zonal and fancy races. The method most likely to prove successful would be to originate a new race of tuberous-stemmed varieties, by crossing it with other allied species of similar habit.

Pelargonium tetragonium is a curiosity, having square stalks or stems, and small-lobed leaves, which in one variety are margined with bright rose. The flowers are large, the lower petals being much reduced (see 'Bot. Mag.,' t. 136).

Mr E. J. Lowe of Highfield, Nottingham, has for several years endeavoured to obtain seedlings between Pelargonium "Madame Vaucher," and *Geranium sanguineum*, and believes he has effected this bigeneric cross.* Some of the seedlings have flowered, the colours being white, rose, and red, and in some of these supposed hybrids the leaves are curiously contorted, but it is difficult to believe that they are really hybrids between the two plants named. Mr P. Grieve fertilised an ivy-leaved Pelargonium, the day after it had been fecundated with its own pollen, with pollen of a variegated zonal variety, and the seedlings, which have not as yet flowered, are extremely variable; so variable, indeed, as to lead one to infer that the cross had been influenced by the application of foreign pollen to the flower after fertilisation with its own. Dr Denny's experience is that the pollen-bearing parent is prepotent, and this is borne out by his numerous experiments. His mode of manipulation is thus explained by himself: "When I have ascertained by means of my lens that the stigma is in a virgin and suitable condition for impregnation, I immediately smother it with the pollen I purposed employing; and it is owing to this smothering of the stigma by the pollen, as I am informed by Professor Duncan, that I derive the prepotent influence of the male parent; because he says he has found, by careful experiments, that if the ovule be impregnated by the application of a single grain of pollen to the stigma, it is nourished principally by the mother plant, which the offspring will in that case most resemble; but if a large quantity of pollen be applied to the

* Mr Grieve attempted to obtain hybrids from *Geranium pratense* by using pollen of silver-variegated zonals, and some of the seedlings appeared with variegated foliage (see 'Gardeners' Chronicle,' 1876, Part I., p. 699, and Part II., p. 49).

stigma, the ovule would derive nourishment by the superabundant pollen-grains being absorbed and carried down to it, and then the offspring would resemble the pollen-parent."* Mr P. Grieve asks whether pollen of another plant applied to stigmas which have already been fertilised with other pollen, or with pollen from their own flowers, will affect the seedling progeny? Dr Denny says: "The value of the suggestion contained in Mr Grieve's inquiry cannot be over-estimated; for should the theory be borne out by experiment, we may be enabled to obtain new forms or varieties of fruits, vegetables, and flowers that could have been obtained in no other way, or at any rate without paying the penalty of sterility in its products: in fact, should such influence really be found to exist in foreign pollen applied after impregnation, I look forward to the possibility of obtaining results equal to the union of two distinct species, and yet to preserve fertility." †

The object in using a green-leaved, dark-zoned variety as the seed-bearing parent is to secure a robust and vigorous habit in the seedlings, which is very seldom the case when tricolor forms are used as the female parents. The sports above alluded to are frequently produced by seedling plants which have remained in a green-leaved state for two or three years, so that seedlings should not be thrown away too soon.

The following pertinent notes on the management of Pelargoniums after fertilisation were originally contributed to the 'Florist' by Dr Denny: "Between the process of fertilisation and the ripening of the seed, all that is necessary is to give the mother plant room, air, and sunshine, and a fair supply of water, for if permitted to suffer too severely from drought, the fertilised pip, like the foliage, will turn yellow and fall. As soon as the seed has ripened, and shows symptoms of a desire to take wing and be off, pick it, and enclose it in one of the pieces of demy paper; pencil the corresponding number of the tally attached to the stalk of the truss upon it, and at once deposit it in a tin-box, with a close-fitting hinged lid, which box should be kept in a dry, cool position, as exposure of the

* I may here remark that Dean Herbert, Mr Grieve, M. Jean Sisley, Mr Shirley Hibberd, Mr Fenn, and other hybridisers, agree with Dr Denny as to the general prepotence of the male parent, other things being equal; and leaving out the question of constitutional vigour, far more direct evidence can be adduced in favour of Dr Denny's axiom than against it.

† See a valuable and interesting paper by Dr Denny, "On the Relative Influence of Parentage among Varieties of Zonal Pelargoniums," 'Jour. Hort. Soc.,' iv. 16; and an exhaustive essay on cross-breeding these plants, in the 'Florist,' 1872, p. 21; 34, and 50.

seed to the sun's rays or heat after it has been gathered will render it slow to germinate, and cause disappointment, by the irregular manner in which, and the lengthened period before, it makes its appearance above ground."

As to the vitality of Pelargonium seed, the 'Cultivateur' gives an instance of the germination of Pelargonium seeds nine years after they were gathered. In 1866, M. Sisley obtained seeds by cross-fertilisation of the Zonal and Inquinans varieties, some of which were given to Mr Hardy, who sowed a portion in 1867 and kept the rest until the spring of 1875, when they also were sown, considerable care being taken in the operation. Notwithstanding the interval that had elapsed between gathering and sowing the seed, a very large proportion germinated, and the plants are said to be doing well.

Herbert (see 'Am.,' p. 356), speaking of the origin of showy Pelargoniums in 1837, says: "Those who raised Pelargoniums from seed found amongst the produce of certain species a great disposition to intermix and sport, which was occasioned by the accidental transmission of the pollen from one plant to another by the bees, which occurs perpetually in that genus, because many of its flowers are occasionally without anthers, or lose them before the stigma comes to maturity, which causes them to be fertilised by another flower; and in the year 1812 (taking the date from Sweet's 'Hortus Britannicus'), the beautiful cross between *P. citriodorum* and *P. fulgidum* was obtained from seed, and afterwards produced under the name *P. ignescens*, and being fertile it has become the parent of an innumerable variety of the most beautiful plants that adorn our greenhouses. *P. ardens* had been raised two years before, between *P. fulgidum* and *P. lobatum*, and had first pointed out to cultivators that it was possible, through the pollen of *P. fulgidum*, to introduce its brilliant tint of scarlet under a variety of modifications in union with the superior qualities of other species in which it was deficient; but a long course of experiments has shown the impracticability of blending the plants allied to *P. zonale* (which are properly detached by Mr Sweet under the name *Ciconia*) with the true Pelargoniums, which are, however, certainly of one genus with the bulbous-rooted sorts that are found to interbreed with them, and have been improperly detached. Such plants as *P. fulgidum* and *P. echinatum*, which have a stem of a semi-tuberous nature, and capable of enduring a long period of drought, form a curious link between the tuberous and fibrous rooted species."

The scarlet zonal section (*P. inquinans-zonale*), and the

show varieties or large-flowered kinds (*P. grandiflorum-cucullatum*), still form pure and distinct—that is, unblended—races. The ivy-leaved section, however (*P. peltatum-hederæfolium*), has been blended with some forms of *P. inquinans-zonale*, just as have the scented or oak-leaved races, *P. quercifolium-capitatum* or *P. quercifolium-graveolens*, with the Nosegay varieties.

The scented Pelargoniums are not unfrequently grown for their fragrant foliage, and possess a certain economic interest, since *P. capitatum*, or Rose Geranium, is grown very largely in the south of France, and also in Turkey, by the rose-growers, who use an essential oil expressed from it to adulterate otto or attar of roses, while this Geranium oil is not unfrequently itself adulterated with oil expressed from one of the fragrant Andropogons cultivated for perfumery purposes in the Moluccas. The three commonest species are *P. graveolens*, *P. capitatum*, and *P. quercifolium*, or oak-leaved. The first-named (*P. graveolens*) was introduced by Francis Masson in 1774; and although a Cape species, is said to be used everywhere as a hedge-plant in Madeira. *P. quercifolium* was introduced by Masson at the same time as the last; and a near ally, *P. glutinosum* (see 'Bot. Mag.,' t. 143), was sent to Kew by Messrs Lee and Kennedy about 1777. The Rose Geranium (*P. capitatum*) was introduced by the Earl of Portland in 1690. An old crimson-purple-flowered variety, called Rollison's Unique, appears to have been a hybrid or cross-bred raised from this section, and is still grown in gardens, together with three or four of its more modern varieties or seedlings. Mr Sampson, of Yeovil, raised several new varieties of scented or oak leaved Pelargoniums in 1871, these having been obtained by crossing a Cape species with some of the modern Nosegay varieties. These seedlings flower freely, the flowers being of different shades of rosy purple, variously striped or spotted with purple, violet, or crimson on the upper petals. These varieties were sent out by Mr Cannell, of Woolwich, in 1873-74. Mr Wilson Saunders and Major Trevor-Clarke have also raised interesting hybrids from the old Cape species.

Seeds of all the sections of this genus should be sown in February in a gentle bottom-heat; and if potted off carefully, and grown on freely, or planted out in a well-manured and sheltered border, will flower the first year. Fancy or show varieties should be grown on in a frame or pit in pots, and this plan is also generally adopted for those of the zonal section. Variegated, bronze, or tricolor varieties are very readily raised by hybridising dark-zoned green forms, such as Stella, Emperor of the French, &c., with pollen from Mrs Pollock and other

desirable kinds; and even the green-leaved seedlings should be saved, as they frequently throw out the most beautiful "sports," and the coloured branches, if desirable, can then be easily propagated by cuttings. Many of the finest of all the tricolor varieties did not come variegated from seed, but sported from green-leaved seedlings raised by crossing tricolors and other zonal varieties.

Nearly all the species and varieties of Pelargoniums are readily propagated from cuttings of the current year's growth inserted in June, July, or August. The zonal varieties may be inserted even as late as September or October; but it is best to secure the cuttings before the rank watery autumn growth commences. As to where and how to insert cuttings, I think it was the late Donald Beaton who said, in his usual racy way, that the best way to strike them was to dibble them into a south border, and forget all about them till it was time to pot them up. One of the most successful propagators of this class of Geraniums I ever knew always struck his cuttings in a low lean-to house, in a bed of soil over a flue: he never used any pots, but simply dibbled the cuttings into the soil. There was always a nice steady heat, but no damping (damp is the great enemy to guard against). Hard-wooded cuttings of the large-flowered and fancy races may be inserted when the plants are cut back after blooming, or the superfluous shoots may be slipped off and used as cuttings after the plants break. Insert the cuttings in a well-drained pot surfaced with white sand, and set it in an airy position, on a slight bottom-heat of about 65°, until the cuttings show signs of having emitted roots.

Grafting.—Almost all Pelargoniums may be readily grafted, and many exhibitors of fancy and show varieties work their plants on a strong-growing variety of the same section as a stock. The scarlet or zonal group all do well worked on the old Giant Tom Thumb, a vigorous variety sometimes met with as a conservatory or greenhouse climber. Mrs Pollock, Lady Cullum, and others of the golden-variegated zonal section of Pelargoniums, make beautiful heads when grafted on stocks of strong, free-growing, plain-leaved or zonal varieties. Those raised from seed saved from good growers make excellent stocks, as they are both strong and straight. For grafts I select medium-sized, somewhat matured shoots, and after cutting off the head of the stock to the height required, and removing only just as much foliage as may be necessary, I whip-graft them, tying them firmly with bast, and claying them over in the regular way. I then place them in a shady, warm, and somewhat close position, where they hardly feel the check; and as soon as the grafts

make visible progress, to gradually denude the stock of its foliage, so as to give the grafts a greater supply of nourishment.

By grafting in the autumn, and keeping the plants steadily growing through the winter in a warm, light house, stopping and shifting them into larger pots as they require it, I have had plants from eighteen inches to two feet through during the following summer. Buds inserted as in rose-budding will grow, but grafting commends itself as the surest and most expeditious method. These remarks apply with equal force in the case of dwarf, delicate varieties, or those Cape species difficult to strike. Such as these may be worked just above the soil on well-rooted plants of common varieties, and are thus increased more readily than on their own roots. Another advantage this method possesses is, that it can be successfully employed early and late in the season, when an attempt to strike cuttings usually proves a failure except with those who have the best appliances. As before stated, care must be taken to use only the firm shoots for grafts: those made either early or late are generally too soft and pulpy, and are therefore the more liable to rot off before they effect a union.

The ivy-leaved sorts, both green and variegated, worked on tall stems, are particularly handsome, and well repay the time and trouble bestowed on them. Their drooping habit is so well adapted for this position, that even when allowed to follow their own inclination they make very graceful plants, and flower profusely; but by affording them a neat wire trellis, they may be trained to form a pyramid, a balloon, or any other shape, to suit the fancy of the cultivator.

The double-flowering kinds, whether grown into standards or worked, make very handsome objects. Excellent standard plants of variegated ivy-leaved Pelargonium L'Elégante can be obtained by grafting it on to a stem of the old crimson ivy-leaf.

In the 'Gardeners' Chronicle,' 1844, p. 213, a correspondent mentions that in 1842 he grafted a plant of Beauty of Ware with ten grafts of other varieties, including Smith's Superb Scarlet, Carnation Scarlet, Frogmore Scarlet, and the old Variegated-leaved Scarlet.

It is a well-known fact that pure white-leaved seedlings of Pelargoniums, and other plants which are in fact albinos, die off after they attain a certain size. I have, however, repeatedly saved these albinos by carefully grafting them on rooted cuttings, which are less variegated, as stocks; and where these seedling albinos are growing near others less variegated, they can often be inarched, and thus preserved, since grafting supplies them with sufficient chlorophyll to enable them to carry on their

functions of vegetative growth. A young green leaf, or a variegated leaf with green in it, might possibly be grafted or inarched on the albino itself by a clever operator.

Double-flowered Varieties.—The double Geraniums, which have attained a popularity far greater than they deserve, although usually classed as "zonal," are apparently derived both from *P. zonale* and *P. inquinans.* Although of comparatively recent introduction to this country, they have long been known on the Continent. A deputation of the Caledonian Horticultural Society of Edinburgh made a tour through parts of Flanders, Holland, and northern France in the autumn of 1817, and in Patrick Neill's journal of its observations is the following passage: "An ornamental variety of *Pelargonium inquinans*, with double flowers, is very common at Ghent, no fewer than ten different competitors having exhibited flowering specimens of it at the last festival." M. Jean Sisley says that M. Lecoq, of Clermont-Ferrand, had a double zonal Pelargonium named Triomphe de Gergovia in cultivation several years previous to 1867. Pollen from this variety was used by M. Lemoine to fertilise the fine pink zonal, Beauté de Suresnes, and from this union the well-known double, Gloire de Nancy, was obtained in 1865. The first double white, Aline Sisley, was obtained in 1872 by M. Sisley, who has since raised other very fine white, scarlet, and rosy varieties. Mr T. Laxton, of Stamford, has also raised some very fine double-flowered varieties—one of the best, Jewel, having vivid deep scarlet florets exactly like Senateur Vaisse Rose in miniature.

Jewel was raised from seed of Madame Rose Charmeux—a French double form of the Tom Thumb or *P. inquinans* type—crossed with Lord Derby, a single scarlet zonal. Madame Rose Charmeux is, as Mr Laxton informs me, a very full flower; and except under starvation and at certain seasons, generally early in the year, it is difficult to obtain seed from this variety. Most of the other double varieties obtained by Mr Laxton are from Mr W. Paul's double-scarlet Cottingtoni, which, being only partially double, seeds freely. This variety is the seed-parent of Aurora, and all others of that type, including Emily Laxton. Both Madame Rose Charmeux and Cottingtoni are sports from Tom Thumb, and their progeny does not cross kindly with the old doubles of the *P. zonale* section. "It is very singular," writes Mr Laxton, "that while the crosses of Madame Rose Charmeux hardly ever produce offspring less double, although sometimes more so, than the parent, unless, indeed, they follow the single male parent altogether in this respect, and are themselves quite single,—on the other hand,

seedlings from Cottingtoni rarely come more double than that variety."

Large-flowered Varieties.—Show or Stage Pelargoniums belong to another group, and are supposed to have sprung from *P. grandiflorum* (*P. hortulorum*), a Cape species introduced by Masson in 1794. Normally it is a white-flowered plant of loose habit, having a very long slender tube to the calyx, and long petioles or stalks to its deeply-lobed leaves (see Sweet's 'Geraniaceæ,' t. 29, or Andrews' 'Botanist's Repository,' t. 12). Another lilac-purple-flowered Cape species, *P. cucullatum*, also appears to have been one of the progenitors of our show Pelargoniums, this plant having been introduced by the Earl of Portland about 1690. Dr W. Harvey, the late lamented and talented author of the 'Cape Flora,' describes it as very commonly grown as a hedge-plant about Cape Town, and he also considers it as one of the original species whence our modern show varieties have sprung. It is a little singular to note that in 1875 a double-flowered form of the purple-lilac-flowered *P. cucullatum* made its appearance at one of the meetings of the Royal Horticultural Society, its owner having grown it in his window. This plant was first exhibited by a Mr Woodward, of whom Mr W. Bull purchased the plant for trade purposes. Semi-double varieties of *P. grandiflorum*, or show Pelargoniums, are now very popular; but twenty or thirty years ago such forms were not sought after so eagerly. In 1850 *P. Willmore Surprise*, a semi-double, made its appearance, but appears to have died out unregarded (see 'Gard. Chron.,' 1850, p. 575). Both Andrews' and Sweet's figures describe some of the old Pelargoniums as species, but their names were ignored by Dr Harvey; and it is evident that they are for the most part hybrids or cross-bred varieties. *G. angustum* is described by Andrews as having been raised by Mr Perry, nurseryman at Banbury, Oxfordshire, and was originally sold by the raiser at a guinea a plant. It has coarse serrated deep-green leaves and pink flowers, the upper petals striped with dark red. *G. pubescens* of the same author is also described by him as "the compound production of several different species." It has its leaves and young growth copiously clothed with soft downy or villose pubescence, the flowers being lilac-pink, and veined with dark red on the two upper petals. Some of the older varieties figured by Sweet may still be found in the cottage windows in country places.

The origin of the Fancy or small-flowered Show Pelargonium is not very clearly defined; but in course of a conversation on the subject at the annual meeting of the Pelargonium Society

(1875), Mr Cooling, of Derby, stated that he believed the first variety of this class was raised forty years ago, and distributed under the name of *P. Willoughbyanum*, and that it had been bred from the ordinary varieties of the period, mentioning, among others, Moore's Victory and Fair Helen.

Ivy-leaved Varieties.—The Ivy-leaved section of this genus has originated from *P. peltatum*, which was raised in the Duchess of Beaufort's garden in 1701 from seeds brought from the Cape, and soon became a general favourite, on account of its elegant ivy-like habit of growth. *P. L'Elegante* is a white variegated variety, the edges of the white leaf-margins turning a delicate carmine if starved in a pot and fully exposed to the sun. There is also a distinct variety having a dark zone in the centre of the leaf.

Mr John Wills, to whom we are indebted for the race of "bronze zonals," was, I believe, the first hybridist who effected a cross between the ivy-leaf (*P. hederæfolium*) and Zonal (*P. zonale*) sections of this genus; and the results of this cross were the two distinct forms known as *Willsii* and *Willsii rosea* (sent out about 1867-8), and Lady Edith. A few years later a singular chance seedling made its appearance on the Continent, and we find it thus described in the 'Gardener's Chronicle' at the time of its appearance: "It is believed to be an accidental cross between *P. hederæfolium* and *P. zonale*, and, what is more, it freely bears seed. M. Jean Sisley describes it as near *P. hederæfolium* in its prostrate habit of growth, with leaves more like those of *P. zonale.* The flowers are of a dazzling red, and there are from fifteen to twenty in each truss. It was found in a garden at Nice, in a bed planted with several varieties of the zonal section, and a lilac-white variety of *P. hederæfolium.* M. Sisley considers it a great acquisition, mainly, it appears, on account of its fertility—a quality not possessed, he says, by *Willsii*,* *Willsii rosea*, Emperor, and Dolly Varden. He thinks it may probably give birth to a distinct new strain, in the hands of a clever hybridiser."

P. peltatum was figured a hundred years ago (see 'Bot. Mag.,' t. 20), and it is curious to observe how little a century of culture has altered this fine old species.

One of the most recent additions to the ivy-leaved garden varieties is a double-flowered form named König Albert. This was raised by M. Otto Leibmann, and was first exhibited in

* Mr Laxton is said to have obtained a few seeds of Mr Wills's *P. zonale-hederæfolium* hybrids, which exactly reproduced the mother plant. It is also curious to observe that Madame Vaucher, Christine, and other varieties, reproduce themselves with tolerable certainty from seeds.

this country by Mr W. Bull, who showed a flowering plant (together with a double-flowered form of *P. cucullatum*) at one of the Regent Park exhibitions in 1875.

Mr Grieve has succeeded in raising a strong-growing, free-flowering cross between a seedling from Madame Vaucher named Culford Rose and *P. peltatum elegans*. This cross-bred form has been named Emperor, and is so luxuriant that in favourable situations it will grow ten to twelve feet in a season.

The same hybridist has obtained a distinct bronze ivy-leaved Pelargonium named Dolly Varden. It was obtained by fertilising an ivy-leaved variety by pollen of a bronze zonal, and the result is a well-marked gold and bronze ivy-leaved variety, of robust and compact habit. The flowers are crimson, and the leaf of a rich golden tint, with a bronze zone, the older leaves becoming tinted with red at the margin.

It is to be regretted that both Mr Grieve's varieties, as well as those raised in this section by Mr Wills, are nearly useless for cross-breeding purposes, as they rarely produce either perfect seeds or fertile pollen.

THE GESNERA FAMILY (*Gesneraceæ*).

A large and ornamental genus of South American plants, part of which are shrubby in habit, as in *Gesnera pardina*, *G. elongata*, or *G. libanensis*; while another section is characterised by having catkin-like stolons, as in *Achimenes*, *Tydæa*, and *Gesnera zebrina*; and a third group has tuberous rhizomes, as in *Gloxinia*. Nearly all the species may be propagated freely by dividing the rhizomes or stolons.

Achimenes.—A beautiful family of stove-flowering herbs, conspicuous on account of their lovely blue, scarlet, or purple, tubular, broad-limbed flowers, which are very freely produced. They are principally South American.

Achimenes coccinea (see 'Bot. Mag.,' t. 374).—This pretty little scarlet-flowered species is a native of Jamaica, whence it was introduced in 1778. This was the first species grown in our gardens.

The numerous varieties are easily multiplied by dividing the scaly underground tubers, and new forms may be readily obtained from seed. Seeds of all Gesnerads germinate easily if sown on the surface of a light, moist, and sandy compost, covered with a sheet of brown paper to obscure the light and to prevent the soil becoming dry by evaporation. The seeds, like those of *Calceolaria*, *Primula*, and many other plants, are

so extremely small that no covering of soil is required, and the compost should not be watered above until after the seeds have germinated. If the soil shows signs of dryness before germination has taken place, moisten it with fine spray from either a syringe or spray-producer. To do this with a syringe without disturbing the surface of the soil, although easy to the practised propagator, is difficult to the amateur. Another plan is to plunge the bottom only of the seed-pan into a vessel of tepid rain water, allowing it to remain a few minutes, so that the soil may become moistened by the capillary attraction of its particles. This genus, as well as Gloxinia and Gesnera, has been much improved of late years by hybridising.

Æschynanthus.—A very showy genus of half-shrubby, evergreen Gesneriaceous plants from Java, Borneo, and other parts of tropical Asia, often cultivated as basket-plants in our plant stoves. *Æ. speciosus*, *Æ. longiflorus*, *Æ. Lobbianus*, *Æ. tricolor*, and *Æ. javanicus* are well-known examples. *Æschynanthus splendidus* is a showy garden hybrid raised between *Æ. grandiflorus* and *Æ. speciosus*, and is the finest of all the strong-growing kinds, bearing ten to twelve vivid scarlet flowers in a cluster, the segments being marked with dark brown. Cuttings of the stem root very freely, inserted in a pot of light sandy compost, and plunged in a mild bottom-heat of 75° to 80°. If the atmosphere is very dry, they should be covered with a bell-glass, or the pot may be plunged in a close case. These plants frequently push out roots from the joints when grown in a humid atmosphere, and branches can be cut off and potted at once.

Agalmyla.—A small genus of stove-plants closely allied to *Æschynanthus;* but the leaves are alternate, and only two stamens are fully developed. *A. staminea*, a native of Java, Borneo, and Sumatra, bears Gloxinia-like leaves and axillary clusters of brilliant scarlet flowers. The plant roots readily at the nodes, and is easily multiplied either by layers or cuttings in heat.

Gesnera (*Nægelia*).*—Well-known velvety-leaved flowering-plants from South America, represented in our gardens by *G. zebrina*, *G. refulgens*, *G. cinnabarina*, and numerous hybrids raised by Louis Van Houtte between *G. amabilis* ('Flore des Serres,' xii. 21) and a fine variety of *G. zebrina* named *splendens* (see Van Houtte's 'Catalogue of Gesneriaceous Plants,' for 1875, p. 4). It is difficult to form any idea of the possible improvement which may yet be effected by cross-fertilising

* Cultivators interested in Gesneriaceous plants should see 'Les Gesnériacées,' p. 83. Librairie Agricole, Rue-Jacob, 26, Paris. 10d.

Gesneras with Achimenes, Eucodonias, and perhaps also with Gloxinias. *Eucodonia nægelioides* ('Flore des Serres,' xvi. 1) is the result of *Eucodonia Ehrenbergii* having been artificially fecundated with pollen from *Nægelia zebrina splendens.* It is only in the flower, however, that a slight resemblance to the parent plants can be observed. By the form of the foliage, as well as the ribs and woolly undersides of the leaves, one is reminded of *Eucodonia Ehrenbergii.* The foliage of *E. nægelioides* is broad, rigid, plain, and handsome; the stiff peduncles are tinted with red. The flowers, which are charmingly disposed, are of fine form, and as large as those of the parent plants. Colour, violet veering to red; edges and lobes perfectly flat, and of velvety crimson; orifice to the centre of the throat bright citron yellow, spotted with crimson amaranth. There are two or three other seedling forms of this hybrid, for figures and descriptions of which see 'Flore des Serres,' xvii. 79; xviii. 117; and xxi.

G. Donkelaarii ('Flore des Serres,' ix. 119; 'Bot. Mag.,' 5070) is one of the most striking of all hybrids, its procreator or seed-parent being *G. discolor* fertilised by a cross-bred variety of *Gloxinia rubra.* *G. Douglasii* has yielded numerous beautiful varieties fertilised with pollen from a crimson-flowered variety; and seedlings of *G. refulgens* are also very variable. It is quite as impossible to trace the parentage of the numerous hybrids and seminal varieties in this genus as it would be in either Calceolaria or Pelargonium. The only distinct genera yet unoperated on by the hybridiser would appear to be Dolichodeira and Stenogaster. We may mention the following hybrid on the authority of M. Van Houtte: *Dircæa* (*Gesnera*) *purpurea* (*G. Douglasii verticillata* × *Dircæa Cooperii*); and a race of beautiful hybrids has also been obtained between *Dircæa lobulata, Lem.,* fertilised with pollen of *Gesnera Leopoldii, Schwd.*

Nægelia margarita is a seedling raised by M. Desmoulins of L'Isle-Adam, and is a cross between *N. amabilis* and *N. alba lutescens.* The flowers are pure white.

Sciadocalyx Lucianii, Ed. André (see 'L'Illustration Horticole,' 1874, p. 147, pl. 182).—This is a beautiful hybrid obtained by M. Lucian, Linden, between *Sciadocalyx digitaliflora* and *Tydæa pardina* (see 'L'Ill. Hort.,' vol. xx., pl. 152). It is a vigorous-habited plant, having hairy stems, broadly lanceolate leaves, and purple-crimson flowers mottled with purple. Other hybrids have also been obtained between *Sciadocalyx* and other genera, of which we are to hear anon.

A very interesting observation, which gives a clue to the ease with which Gesnerads are cross-fertilised and hybridised in our

gardens, has been made by Miss S. S. Dowson (see 'Jour. Bot.,' 1873, p. 103): "Some Achimenes have a tubular corolla five-cleft, with a swelling just below the top of the throat. There are four perfect stamens, not much differing in length, and the stigma is ultimately two-cleft. In the bud the pistil is much shorter than the stamens; but by the time the bud is just opened, it has lengthened out between the stamens, and its tip is adpressed to the upper lip of the corolla. As yet the stigma has its two branches closely folded together. The anthers at this time are all four close beneath the end of the pistil, and open downwards. The filaments then begin to contract, and the anthers, which adhere together, are drawn lower; and finally the filaments twist themselves up to such a degree that the anthers are drawn down to the very base of the tube. The object of this is clearly to get them out of the way of the stigma, for during the process the pistil has arched forwards and downwards, and the two branches of the stigma have opened. They will be seen to form a fork over a slight rising in the middle lip of the corolla, by which entrance to the flower, except exactly under the stigmatic surfaces, is prevented."

Achimenes Rollisonii is a beautiful hybrid, raised and distributed by Messrs Rollison & Sons, Tooting. It has large Gloxinia-like lavender-purple flowers, spotted in the throat with crimson and yellow, and is the result of a cross between *A.* (*Plectopoma*) *gloxiniæflora* and *A. Scheerii* (see 'Floral Magazine,' t. 217). *A. Gibsonii* bears large mauve or lilac fringed flowers, with a white tube. It also is a seminal variety raised by Messrs Rollison & Sons. These plants were the first break from *A.* (*Plectopoma*) *gloxiniæflora*. Other beautiful hybrids from Continental gardens are too numerous to mention in detail, scarcely any two seedlings being exactly alike. Among the oldest hybrids obtained may be mentioned *A. Escheriana*, obtained by M. Regel, at Zurich, between *A. rosea* fertilised with pollen of *A. longiflora*. M. Roezl, now one of the most experienced botanical travellers, was one of the first cultivators who hybridised Tydæas in M. Van Houtte's nursery at Ghent, and numerous forms resulted from *T. Warscewiczii* and *T. picta* crossed reciprocally, one of these hybrids being *T. gigantea*—a seedling from *T. picta*. *T. Regelii* is a seedling from *T. Warscewiczii*, the cross being in this case reversed.

Mandirola (*Nægelia*) *Roezlii* is a hybrid from *Gesnera discolor*, fertilised with pollen from *Scheeria mexicana*.

M. (*Nægelia*) *picturata* of Planchon is a hybrid from *M. multiflora*, fecundated with pollen from *Gesnera zebrina*.

Another of M. Van Houtte's hybrids is *Tydæa Ortgiesii*, the

seed-parent being *T. Warscewiczii*, fecundated by pollen from flowers of *Locheria magnifica*.

The new Plectopomas raised by M. Van Houtte differ so much from their type *Plectopoma gloxiniæflorum*, that a botanist would have some difficulty in discovering the affinity, though they inherit in a great measure the foliage of the type. In respect to habit, they are far superior; for instead of producing their flowers towards the summit only, the plants become complete floral pyramids, covered from base to summit with large well-shaped flowers of various forms, and of innumerable shades and colours.

These beautiful varieties were originated by crossing *P. (Achimenes) gloxiniæflorum* with *Gesnera (Nægelia) zebrina*, and others of the same type.

Gesnera macrantha is the result of a cross between *G bulbosa* and *G bulbosa Cooperii*. *G. macrantha* crossed again with another cultural variety of *G bulbosa* produced *G. macrantha purpurea*, and singularly enough the last-named form has been imported from the natural habitat of *G bulbosa*, a fact which seems to afford some proof of the constant modification of plant-form going on throughout the world The imported flowering tuber of *G macrantha purpurea* was exhibited at South Kensington, 7th April 1868.

Coloured figures and descriptions of the following hybrid Gesnerads are given in the 'Flore des Serres'—

Eucodonia Nægelioides diamantina, 1870,		page 149
Tydæa "Robert le Diable,"	"	" 131
Plectopoma Eucodonioides,	"	" 59
" *Nægelioides suave roseum*, 1874,		" 61
" " "Colibri,"	"	" 71
P. myriostigma and *P.* "Ruban Rose," 1873,		" 61

Tydæa Vesuvius (see 'Revue. Hort.,' 1868, p. 151) is one of the finest of all the seedling or hybrid forms. It was raised by M. Georges Rosciaud, who has also succeeded in obtaining numerous other fine varieties, including *T. venosa* and *T.* "Rachel." In obtaining these fine forms, this facile hybridist fecundated several kinds of *Tydæa* (*Achimenes*) with pollen of *Locheria magnifica*, the result being a race of brilliant rose or scarlet flowered hybrid *Tydæas*, with rich spotting or marbling on the limb of the tubular flowers.

It does not appear to be generally known that *Plectopomas*, *Gesneras*, *Tydæas*, *Achimenes*, and most other Gesneraceous plants, are easily propagated from cuttings of the young growth —*i.e.*, tops taken off below a joint, and inserted in a pan of

silver sand and a little leaf-mould mixed, or in sawdust, on a genial bottom-heat of 65° to 75°. Even the old leaves pricked into sand on a gentle bottom-heat root and form little tubers as freely as Begonias.

Gloxinia.—Tuberous-rooted, tropical, American plants, with fleshy leaves and solitary flowers on erect scapes. *Gloxinia speciosa* (see 'Bot. Mag.,' t. 1937) is the original parent of the large-leaved race, with drooping purple flowers, and it is a common occurrence for seedlings of the best modern erect-flowered varieties to revert to this form. All the older forms

Hybrid Gloxinias.

bore drooping flowers until the appearance of *G. Fyfiana* (a seminal variety raised by M. Fyfe at Cothesay in 1845), and supposed to be a hybrid between *G. speciosa*, var. *maxima*, × *G. caulescens*, which, according to Mr B. S. Williams, was the first variety having erect flowers; and from this, crossed with other finely-coloured forms, we have now a race of very valuable erect-flowered kinds, which show the delicate markings of the throat and limb better than the drooping or pendulous-flowered varieties.

Another Continental variety, *G. Eichlerii*, a white flower

variegated with rose and bluish lilac, is known to be a hybrid between *G. speciosa* and *G. caulescens*.

Among the earliest varieties of *Gloxinia speciosa* raised in English gardens were four exhibited by Mr R. Glendinning of the Chiswick Nursery, at the house of the Horticultural Society, Regent Street, in June 1844, and to which a Banksian medal was awarded. These were named respectively, *G. magnifica*, *G. insignis*, *G. bicolor*, and *G. Cartonii*, and were raised by Mr Carton, then gardener to the Duke of Northumberland at Syon, who was celebrated for his skill in hybridising. These plants were raised from a seed-bearing plant of *G. speciosa rubra*, fertilised with pollen from *G.* (*Sinningia*) *guttata*. For a figure of *G. maculata*, see 'Bot. Mag.,' t. 1191. It has been grown in English gardens since 1739.

Dolichodeira.—*D. tubiflora* (*Gloxinia tubiflora*, *Hook.*) is one of the most distinct of all Gesnerads, bearing long white pendulous flowers from the axils of its oblong-crenate, opposite foliage. It is cultivated at Kew and Chiswick, and is readily propagated either from cuttings or seeds. It requires to be grown in the full sunlight, in order to flower it freely. It is so distinct in the form of the flower that one can only wonder at its having escaped the hybridiser so long. It was introduced in 1847 from South Brazil.

Stenogaster.—A small South American genus of miniature Gesnerads, represented in our gardens by *S. concinna* ('Bot. Mag.,' t. 5253; 'Flore des Serres,' xv., pl. 65), and a closely-allied form, *S. multiflora*, both bearing lilac-purple flowers. Seeds grow freely. The plants should be grown in thumb-pots plunged in a flat pan of sandstone grit, among which the seeds fall, and are not so apt to damp off as when sown in soil.

Streptocarpus.—A free-flowering genus of blue or lilac flowered Gesnerads, from the Cape of Good Hope. There are four species: *S. Rexii*, one form of which bears two flowers on a scape, and is grown in gardens under the name of *S. biflora*; *S. polyanthus* (many-flowered) ('Bot. Mag.,' t. 4850); *S. Gardenii* ('Bot. Mag.,' t. 4862); and *S. Saundersii* ('Bot. Mag.,' t. 5251). They are free-blooming and very interesting little plants, well worth the attention of the hybridiser. These plants, like Gloxinias, are readily propagated by leaf-cuttings. They seed freely, bearing the seeds in long twisted capsules often 5 or 6 inches in length. The seeds should be sown on the surface of a pan of sandy compost, as recommended for Achimenes. It is interesting to observe that one of the cotyledons remains, and in the case of *S. Rexii* forms the whole leafage of the adult plant. We have already one very

handsome free-flowering hybrid in this genus—namely, *S. Greenii*, the result of a cross effected by Mr H. Green of Reigate between the old one-flowered *S. Rexii* and the many-

Streptocarpus Greenii.

flowered *S. Saundersii.* The seedling plant exhibited and certificated at South Kensington in 1875 bore three leaves and twenty flower-spikes, many of which bore three to five bluish-lilac purple-streaked flowers. Mr Green informs me that he

has since raised a batch of seedlings from this hybrid, which proves its fertility. It will now be interesting to know whether these seedlings reproduce the hybrid, or if they show traces of reversion.

Messrs E. G. Henderson & Sons have raised several hybrid varieties of Streptocarpus which are not yet named; and several hybrids between *S. biflora* and *S. polyanthus* have been raised in Continental gardens.

THE CEREAL FAMILY (*Graminaceæ*).

One of the largest of all natural orders of plants, and one of the most important, as affording valuable food-producing plants which are widely distributed in both tropical and temperate countries. In the 'Vegetable Kingdom' is the following account of their distribution: "The distribution of cultivated grasses is one of the most interesting of all subjects. It is determined not merely by climate, but depends on the civilisation, industry, and traffic of the people, and often on historical events. The grains which extend farthest to the north in Europe are Barley and Oats. These, which in the milder climates are not used for bread, afford to the inhabitants of the northern parts of Norway and Sweden, and of a part of Siberia and Scotland, their chief vegetable nourishment. Rye is the next which becomes associated with these, and it is the prevailing grain in a great part of the northern temperate zone —namely, in the south of Sweden and Norway, Denmark, in all the lands bordering on the Baltic, the north of Germany, and part of Siberia, where Buckwheat is also frequently grown. In the zone where Rye prevails, Wheat is generally to be found. In temperate and southern parts of Europe, Wheat is very general, Barley being used for malting, and Oats and Rye as cattle food. Next come warmer districts, where Wheat is still grown at a high elevation, other grain-plants being Maize, Rice, and Millet of several kinds. In the torrid zone, Maize (*Zea mays*) predominates in America, Rice (*Oryza sativa*) in Asia, while both are grown nearly equally in Africa. Hence it appears that in respect to the predominating kinds of grain the earth may be divided into five grand divisions or kingdoms— the kingdom of Rice, of Maize, of Wheat, of Rye, and lastly of Barley and Oats. The first three are the most extensive, Maize having the greatest range of temperature, but Rice may be said to support the greatest number of the human race." It is a very remarkable circumstance that the native country of

Wheat, Oats, Barley, and Rye should be entirely unknown. This has led to an opinion that all our cereal plants are artificial productions obtained accidentally, but retaining their habits, which have become fixed in the course of ages (see 'Gard. Chron.,' 1844, p. 555, 779). Numerous other grain-plants are cultivated to a limited extent in warm climates, and their number might be readily augmented, since nearly all grass-seeds are wholesome; and being alike albuminous, they are equally nutritious with the kinds generally grown, the latter being preferred on account of their superior productiveness.

The reproduction of all grasses and cereals is of the simplest possible description, nearly all being annual plants, the seed of which germinates very readily in all kinds of soil. The tender ornamental kinds should be sown in pans of light, rich earth, and be placed in a gentle bottom-heat to assist germination. Many of the ornamental perennial grasses, Bamboos, and Arundinarias, are easily propagated by division; or, as in the case of *Sorghum*, *Arundo*, *Arundinaria*, &c., pieces of the stem may be cut and laid on damp moss or earth in a close heated case, where they develop buds at the nodes and produce young plants. Many of our most useful forage grasses are evergreen, and add much to the freshness and beauty of temperate countries.

At Fota, Cork Harbour, many species of Bamboo attain noble dimensions, planted in little islets on the margins of the ornamental water, and in the summer of 1875 these seeded very freely, and numerous seedlings sprang up naturally. These seeds resemble Black Oats, and lie rather long before germination: even in a bottom-heat of 70° they lie two months before they make their appearance.

The following are amongst the most useful and ornamental genera in this valuable group: *Oryza* (Rice), *Zea* (Maize), *Coix*, *Alopecurus*, *Phleum*, *Phalaris* (Canary-seed), *Holcus*, *Panicum*, *Oplismenus*, *Penniseteum*, *Gymnothrix*, *Stipa*, *Agrostis*, *Arundo* (Reeds), *Chloris*, *Lagurus*, *Aira*, *Avena* (Oats), *Poa*, *Eragrostis*, *Glyceria*, *Briza* (Quaking-grass), *Dactylis*, *Festuca*, *Bromus* (Brome-grasses), *Arundinaria*, *Bambusa*, *Lolium* (Rye-grass), *Triticum* (Wheat), *Secale* (Rye), *Hordeum* (Barley), *Saccharum* (Sugar-cane), *Sorghum* (Millet).

From a letter by J. D. Boswell-Syme, LL.D., in the 'Jour. Royal Hort. Soc.,' 1873, vol. iv. (N.S) p. 7, it appears that Wheat and Barley are self-fertilising plants: "I made out pretty well about the intra-palear fertilisation of Wheat this year, and have been meaning to send you the results. The anthers are empty except a few accidentally adherent grains when they are

excluded.* This was proved, first, by extensive examination in the Wheat-fields, and by bringing a large supply of Wheat-heads about to flower into the house and putting them in water, with a paper under the glass so as to see if any pollen fell down; secondly, by the examination of the stigmas of flowers with their anthers still included; thirdly, by the fact that the stigmas are never protruded at all." †

Our cultivated Wheats (*Triticum sativum*) are now generally believed to have originated from *Ægilops ovata*, a European grass of trailing habit, the rachis being extremely brittle. Cultivation—*i.e.*, sowing seeds thickly together—induces a taller and more erect habit, and a stouter culm is also the natural result of better food in less limited quantities. In the 'Cyclopædia of Agriculture' ("Triticum"), Mr Bentham observes that M. Esprit Fabre of Agde, in the south of France, has shown how readily wild characters "become modified by cultivation; and wide as is the apparent difference between *Æ. ovata* and common Wheat, he has practically proved their botanical identity; for from seeds of the *Ægilops*, first sown in 1838, carefully raised in garden soil, and resown every year from their produce, he had, through successive transformations, by the eighth year (1846) obtained crops of real Wheat, as good as the generality of those cultivated in his neighbourhood." (See 'Sc. and Prac. of Farm. Cult.' (Buckman), p. 164.) Further information on the origin of Wheat may be obtained from the 'Bulletin de la Société Botanique de France,' t. viii. p. 614. The cultivated Oats (*Avena sativa*) again have, according to Prof. Buckman, originated from *Avena fatua*, a very troublesome weed-grass, to which indeed the cultivated or ennobled Oat frequently degenerates. Prof. Lindley, however, in the article "Avena," in the 'Cyclopædia of Agriculture,' supposes *A. strigosa*, the "Bristle-pointed Oat," to be the original parent of the cultivated varieties. Barley (*Hordeum distichum*) is found wild in Mesopotamia, and also on the ruins of Persepolis, specimens from the last-named locality having ears scarcely so long as starved Rye. All the cultivated varieties, including the "six-rowed" Barley (*H. hexastichum*), have originated from the species above-named, the only difference

* Confirming the observations of Dr Boswell-Syme, 'Jour. of Botany,' 1871, p. 373; and Bidard, Comptes Rendus, 1869, p. 1486.

† See 'Gard. Chron.,' 1873, p. 362, 400, for an abstract from a paper by Prof. Hildebrand of Freiburg on the "Fertilisation of Grasses," read before the Berlin Academy of Sciences in 1872; also a paper on "Wheat and Rye Hybrids," 'Gard. Chron.,' 1875, p. 496; and *ibid.*, 1873, p. 362, 400, for a paper on the "Natural Cross-Fertilisation of Monœcious, Diœcious, Protogynous, and other Grasses."

being that in *H. distichum* some of the spikelets are barren, while in others they are fully developed or fertile. Rye is the hardiest of all our cereals, and is found as a wild grass on the granite mountains of the Crimea at altitudes of 5000 to 6000 feet; and Prof. Buckman remarks that its northern habitat explains why it is so much hardier than any variety of Wheat, the southern origin of which is now ascertained. Rye is the least variable of all our cereal crops.

The varieties of Wheat and other cultivated grain-plants are much greater than is generally supposed. Of Wheat we have two races—the hardy or autumn-sown varieties, and the ordinary or spring-sown Wheat. Among the varieties are red and white skinned forms; and some of these have awned heads, while others have not. In the 'Gardeners' Chronicle,' 1871, p. 1496, 1497, fourteen distinct varieties of Wheat are figured and briefly described, including "Hallett's Pedigree" Wheat, which has heads 6 to 8 inches in length, filled throughout with plump grains of more than average size. This strain is the result of careful selection; and by good culture and still further selection, with occasional change of soil, we might obtain varieties of Wheat still more productive.

The accidental origin of many of our present varieties of corn is not a little curious, as showing what "great events" sometimes "from trivial causes spring." For instance, some thirty years ago, the Suffolk sort of white Wheat originated with Mr Hardcastle, a farmer near Ipswich, merely by the accident of a very fine ear sticking behind the button of his coat, as he was one day descending the ladder from the mow. Other sorts, as the "Yellow Lammas," the "Devonshire White," and the "Golden Swan" were, it is said, obtained in the same accidental way. The Talavera was introduced from Spain (where it had been discovered and cultivated) by a small quantity of it being left in the store of a quartermaster on the arrival of the troops in England, and given to a gentleman near Exeter by Colonel Stanley. The different varieties of Oats, too, owe their origin to circumstances no less singular. The Potato Oat, for example—one of the most remarkable of any of its species—was first observed growing in a field of Potatoes in Cumberland, about fifty years ago; and from the produce of a single stalk, which there sprang up by accident, has been produced the stock now in general cultivation. So with respect to the Hopetoun Oat, discovered in a singular manner by one of the most experienced and intelligent Lothian farmers, Mr Patrick Shirreff. "Having occasion," he says, "frequently to pass the gateway of a field bearing a crop of Potato Oats, in the

summer of 1824, a stalk of remarkable height often attracted my attention. On reaping the crop, the grains supported by this stalk, and those by a short one proceeding from the same root, were gathered together, and in the following spring included in a collection of Oats obtained during a tour in some English districts, and cultivated with a view of ascertaining their respective peculiarities. The crop from the grains of the gigantic stalk was again conspicuously tall. The following year (1826), remarkable for drought, was unfavourable to the growth of the Oat-plant in East Lothian, which circumstance, in connection with the crop of the Hopetoun Oat being deposited at the corner of a barn, where it was preyed on by mice, prevented increase of quantity this year; and it was not till the year 1827 that the Oat ingratiated itself in my good opinion. In 1828 a bushel of this Oat was presented to Robert Wallace, Esq. of Kelly. In the spring of 1830 it was offered to the public, and sold to forty-three individuals. The following autumn it was sent to several foreign countries." "Entertaining," says Mr Shirreff, "a lively interest for the fate of a plant, named as a tribute to the memory of one of the most amiable of modern characters, and which had occupied time and attention in raising, I circulated queries regarding the Hopetoun Oat amongst the individuals who purchased seed, by which I was furnished with many reports of experiments and statements highly favourable to this plant, both in regard to quantity, meal, weight of straw, &c." Mr S. subsequently says—"The Hopetoun Oat is now in the cultivation of the country. How I became possessed of it has been already stated; but whether it originated from the sexual intercourse of two known species, from the effects of cultivation, or from a freak of nature, will in all probability remain a secret."

The foregoing facts are brought forward to show what improvements may be effected in our annual plants by the production of new and valuable varieties, where there is an inquiring mind to explore, and a patient assiduity to elicit profitable results by repeated experiments.

THE GOOSEBERRY AND CURRANT FAMILY (*Grossulariaceæ*).

Ribes.—A genus of ornamental flowering or useful fruit-bearing shrubs, principally natives of Europe, America, and of the temperate parts of Asia. The most useful garden plants are the Red Currant (*Ribes rubrum*) and its white varieties; Black Currant (*R. nigrum*); and the common Gooseberry (*R.*

grossularia). All these species are natives of Britain, and from them our cultivated varieties have originated, having been improved by culture, selection, and seminal variation. It is curious to find that a form of our native Gooseberry (*R. grossularia Himalayana*) is found in the Himalayas, and a green-berried variety of *R. nigrum* is a native of Russia, and there are white, green, and flesh-coloured varieties of *R. rubrum*, all supposed to be natives of Britain. *R. sanguineum* and *R. aureum* (North American species, of both of which there are several forms), and others, are common as flowering shrubs. Fifty or sixty species are known to botanists. All the kinds are readily propagated from cuttings of the current year's wood, taken off in autumn, and planted in rows 18 inches apart, leaving a space of 8 or 10 inches between each cutting. The stronger the cuttings the better, say 12 to 16 inches in length; and if planted on the north, or shady side of a north wall or fence, they root freely, and form nice little bushes the first summer. The eyes on the lower part of the cutting should be rubbed off, or they come up as suckers. A few dozen cuttings of good sorts may be struck every season, to supply vacancies, or to give away. Suckers should never be planted, as they rarely form clear-stemmed bushes, and have a greater tendency to throw up suckers than those bushes propagated from cuttings. New varieties are originated from seed; and, notwithstanding the great improvements made in the size of the Gooseberry by Lancashire growers, there is still room for improvement in the three great essentials of edible fruits of all kinds—viz., size and flavour of fruit, and a prolific habit of growth.

The late Mr T. A. Knight raised many cross-bred varieties between the largest red and white fruited Currants, and some of his seedlings bore larger and sweeter fruit than the Dutch and Belgian varieties of his time (see 'Trans. Hort. Soc.,' iii. 207).

All the varieties seed freely, and the seeds may be cleaned by rubbing in dry sand, or in a cloth; after which, sow at once in pans or boxes of light earth, and place the pans in a cold frame until the spring, say February, when place them on a gentle bottom-heat, until the young plants make their appearance. In order to forward the young seedlings as much as possible, a gentle hotbed may be made up, and covered with about 6 inches of light rich soil, into which prick the young plants as soon as large enough to handle, and cover with a frame until they become established; after which, remove the frame, and water freely in hot dry weather. Seedling Gooseberries and Currants fruit the second or third year; but, like

all other fruits, should be fruited two or three [illegible] before they are discarded altogether.

It is singular to note that the Red Currant, Black Currant, and Gooseberry will [illegible] by hybridising, nor will they succeed on each other in any way as scion and stock. The same fact is partially true in the case of the Apple and the Pear, of which hybrids have never been raised, although, as is well known, intergrafting is in their case possible, and not altogether undesirable in its practical results.

Ribes intermedium is a hardy shrub, bearing copper-coloured flowers and black fruits. It is a sport or seminal variety from *R. albidum*, obtained by M. Billiard ('Revue Hort.,' 1867, p. 260).

R. Gordonianum is said to be a hybrid between *R. sanguineum* or "Flowering Currant" and *R. aureum*.

The following are good seed-parents, as they bear fine fruit and are very prolific:—

Red Currants	White Currants	Black Currants	Gooseberries
Red Dutch. Knight's Sweet Red Houghton Castle Red, or Goliah	Common White White Dutch.	Black Naples. " Grape.	Red Champagne Yellow " Warrington. White-smith Early Sulphur. Pitmaston Greengage Wonderful Roaring Lion Topsawyer, and Sovereign.

Gooseberries and Currants are budded on *Ribes palmatum*, *R. aureum*, and *R. tenuiflorum* as stocks, by MM. Croux et Fils, nurserymen at Sceaux, near Paris; and in their nursery may be seen a number of single-stemmed specimens of these Ribes, budded with Currants and Gooseberies of various kinds and colours, the results being as curious as they are ornamental. *Ribes aureum* also forms a good stock on which to bud or graft standard Gooseberries, and, so grown, the fruit gets more light and air, and is of superior flavour to that grown on low bushes, where the lowermost fruits are frequently damaged or soiled by rains. Fine examples of standard Red and White Currants may be seen in the kitchen-garden at Wollaton Hall, near Nottingham, and so grown they take up but little room, are very ornamental, and bear enormous crops of fine fruit; indeed, as much as 8 lb. has been gathered from one of these specimens.

Growing both Gooseberries and Currants on stocks is a practice which deserves notice, and experiments with any of the Ribes in cultivation with this object in view would be interesting; or seedling stocks might be especially grown for the purpose, as is now done in the case of Apples, Plums, and other hardy fruits. Trees grown on stocks 3 or 4 feet in height might be planted in positions where ordinary bushes would be in the way, and the ground beneath could also be sown with Lettuce, Radishes, or other light crops. The fruit on standard trees could also be more readily protected from birds, and being more fully exposed to the air, would hang later than when grown on low bushes in the ordinary way. For an excellent descriptive enumeration of Gooseberries—in all, thirty-six varieties—see 'Trans. Hort. Soc.,' 1835, p. 226.

THE HYDRANGEA FAMILY (*Hydrangeaceæ*).

A small group of shrubs, having opposite leaves bearing cymose clusters of white, pink, or bluish-tinted flowers. Most of the cultivated forms of Hydrangea, such as *H. hortensis*, *H. stellata fl.-pl.*, *H. rosea*, *H. nivalis*, and many others, owe their beauty to the suppression of the sexual organs and the enlargement of the floral envelopes in a way analogous to what takes place in some Viburnums. Mr Hemsley contributes an excellent paper on Hydrangeas to the 'Garden,' 1875, p. 145, from which we learn that most of the forms of Hydrangea in cultivation are forms of *H. hortensis* that have originated in Chinese and Japanese gardens; and this view is held by Dr Maximowicz, who collected and introduced many of these beautiful plants. This fact, Mr Hemsley remarks, "goes to prove that this familiar plant is probably susceptible of further improvement and a wider range of variation." We have before observed that many hybrids which are sterile—*i.e.*, which never bear fertile seeds—have considerably more vegetative luxuriance than nearly-related hybrids which are fertile; but here the enlargement seems confined to the floral envelopes, and it would be interesting to notice whether the early removal of the sexual organs of different flowers has any perceptible effect on the size and after-development of the sepals and petals. We know that Orchid flowers, which have waxy pollen, often keep fresh for months, so long as the stigma remains in a virgin condition; and gardeners have long known that emasculated flowers endure much longer, owing to the fact that fertilisation is impossible. The flowers of Hydrangeas are remarkably persist-

ent; and bearing this fact in mind, it appears to us that races of decorative plants having abortive flowers are much to be desired. Hydrangeas rarely produce seeds; but M. René Rovelli has obtained fruits of *H. hortensis* by thinning out the flower-buds in their earliest stage. The cultivated species are principally natives of China and Japan, and are easily multiplied by cuttings of the young growth, which root readily in a gentle bottom-heat.

Hydrangea otaksa resembles *H. hortensis* in its aspect and its style of inflorescence, but is altogether stronger and bolder in growth. The colour of the florets is pink, and they are produced in enormous globular heads of from twelve inches to twenty inches across. It should make a fine market plant, as well as an admirable subject for greenhouse and conservatory decoration. Outdoors it grows freely, and is about as hardy as *H. hortensis*. If seedlings could be obtained from this or other varieties, we might look for some startling novelties. It would be interesting to know whether the sterile florets of Hydrangeas are due to any long and persistent course of culture adopted by the oriental gardeners. Even such splendid forms as *H.* "Imperatrice Josephine," *H. paniculata floribunda*, *H. acuminata*, and others imported from Japanese gardens, might possibly be much improved if our intelligent horticulturists would set about the task. It does not appear to be generally known that rooted cuttings of *H. hortensis* form excellent stocks on which to graft the choice Japanese varieties; and pieces of the soft thick roots, well furnished with fibres at the lower end, may also be grafted in heat successfully. The operation should be performed in a close case in a humid temperature of 65° to 75°.

THE IRIS FAMILY (*Iridaceæ*).

The plants of this beautiful order are mostly herbaceous, with sword-shaped leaves, as in *Iris* and *Gladiolus;* but in *Witsenia corymbosa* a sub-shrubby appearance is assumed. From Amaryllids they are known by having only three stamens, the anthers being extrorse or turned outwards; and they are also near *Orchids*, from which they differ in having their style and stamens separate or free, and not fused together. They are principally natives of the Cape, Europe, and North America. The Iris-like genus *Moræa* represents *Iris* in warm latitudes. *Crocus*, *Iris*, and *Gladiolus* are three of the most popular genera in this order. Many of the creeping species, as the rhizomatous

Irids, are readily propagated by offsets or division. Gladiolus, Crocus, and the other cormous species, produce lateral offsets freely, which, being separated and planted, serve to multiply the parent plants. Most of the species, especially *Crocus*, *Gladiolus*, the bulbous *Iris*, *Ixias*, *Sparaxis*, &c., seed freely; and seeds grow readily, sown as soon as ripe or in the spring in pots or pans of light sandy earth. The seeds of all Irises should be sown as soon as they are ripe, or any time in the autumn, preserved in a cold frame through the winter, and they will come up in the spring. When not sown till the spring, they generally take twelve months to vegetate; perhaps a slight hotbed would accelerate their germination. As to their treatment, that depends on what kind of Iris they are. The Spanish Iris (*Xiphium*) and the English Iris (*Xiphioides*) are the two sorts generally grown from seeds. They are bulbous plants, and sport into endless varieties from seeds; and the different varieties are increased from offsets of the bulbs, like the Crocus. In dry light soil they are quite hardy.

Here is an order of nearly all hardy flowers, having the glowing colours, fantastic markings, and in many cases the variable forms, of the tropical Orchids, and which luxuriate in all warm sandy soils. What a field for the intelligent hybridiser, notwithstanding the strides which have already been made, especially in the hybrid Gladioli of our own and Continental raisers, the Crocuses of the Dutch bulb-growers, and the lovely seminal cross-bred forms of the bulbous or Spanish Iris and German Iris (*I. germanica*), now so common in our gardens! Let us hope that the graceful *Ixias* and *Sparaxis*, which succeed so perfectly in the Channel Islands, may in like manner be improved. Some of the genera in this order, as *Tigridia* and *Ferraria*, or *Ixia* and *Sparaxis*, or *Babiana*, might possibly be hybridised, and new forms or races thus obtained.

The following are the principal cultivated genera: *Sisyrinchium*, *Libertia*, *Moræa*, *Iris*, *Herbertia*, *Cypella*, *Tigridia*, *Ferraria*, *Witsenia*, *Babiana*, *Gladiolus*, *Watsonia*, *Sparaxis*, *Ixia*, *Trichonema*, and *Crocus*.

Crocus.*—Hardy bulbs, for the most part European. On warm dry soils they readily reproduce themselves by offsets. Many of the species seed freely, and may be grown in pots for this purpose in a cool frame or pit. Seed should be sown as soon as ripe, for if kept until it dries, it does not vegetate till the second year. Sow either in pans in a cool frame, or in a warm sheltered border out of doors. The seedlings flower the

* For a general account of all the species of *Crocus*, see 'Gard. Chron.,' 1873, p. 107 *et seq.*

third or fourth year, and vary greatly in habit, size, and colour of their flowers. *C. vernus*, the British spring or vernal purple-flowered species, seeds very freely in the Nottingham meadows. Seeds from the large-flowered Dutch varieties produce very beautiful flowers. It seems very probable to me that the great diversity of colours and breaks observable in plants of this genus have originated from cross-fertilisation or very striking seminal variation in their native habitats. It is a singular fact that while white or purple Crocuses seed abundantly, the yellow varieties seldom do so. Perhaps, however, the reason of this is that their own pollen is impotent, or it may be owing to their having been multiplied by the Dutch florists from offsets for centuries. Self-fertilisation appears to take place in Crocus at any rate; the anthers frequently discharge their pollen when the flowers are in a very young state—often when the flower-bud is only half grown. It is possible, however, that this may be prevented by the much later development of the style, which may become receptive or remain receptive long after its native pollen is shed, so as to facilitate cross-breeding. Many species and varieties of Crocus bear seed more often than is by many supposed, the seed-pods or capsules being borne down in among the sheaths of the leaves, and often below the surface of the ground; hence they are not unfrequently overlooked.

Gladiolus.—A beautiful genus of fifty or sixty species of Cape or South European cormous plants, but few, however, of which are to be seen even in our best public gardens. To the hybridiser many of the old species would be invaluable. (See vols. i.-xx. of the 'Botanical Magazine' for figures of many beautiful species.) Gladioli are only to be propagated from offsets or from seeds, the first method being employed to multiply and perpetuate species or particular varieties, and the latter to originate new forms. Seeds of some species, however, closely resemble the parent. Gather the seeds in autumn as soon as ripe, and sow in pans or boxes of light rich earth in February, placing the pans in a moderately warm pit or frame. Boxes are to be preferred to pans, as they contain a greater body of soil, and do not become dry so soon. After the seeds germinate, give water freely, and elevate the boxes near the light; in June they may be placed in a sheltered position out of doors, and carefully watered. In September carefully sift out the young bulbs, and plant them in lines in a nursery bed of rich sandy soil, where they can remain until they flower. Save seeds only from good spikes and finely-formed flowers, which should be carefully emasculated ere the anthers shed their pollen; after which watch the stigma, and when it is glu-

tinous or receptive, fertilise it with pollen from richly-coloured varieties, or from another species which possesses some peculiarity desirable to perpetuate.

M. Souchet was one of the first Continental raisers who set about the improvement of the Gladiolus as a show or ornamental florists' flower, and his hybrids were principally obtained by cross-fertilising *G. cardinalis*, a red-flowered Cape species introduced in 1789, *G. pulcherrimus*, and *G. blandus*, a flesh or rosy species, also from the Cape, introduced so long ago as 1744. *G. natalensis*, a scarlet-and-yellow-flowered species introduced in 1830, and *G. floribundus*, a yellow-flowered Cape species, introduced in 1788, have also been employed by hybridisers; and from these five species fused together through their varieties our races of modern show Gladioli have been derived, with perhaps a little of the blood of *G. psittacinus*; and *G. ramosus*, a rosy Cape species introduced in 1838, has been employed by M. Schneevogt, of Haarlem, who has done much to improve these showy flowers.

Dean Herbert appears to have raised many hybrid Gladioli from such species as *G. cardinalis*, *G. blandus*, *G. carneus*, *G. inflatus*, *G. angustus*, and *G. tristis;* and these he describes at p. 365 of his 'Amaryllidaceæ' as varying from white to scarlet, rose, coppery, and blackish purple, some being exquisitely speckled in consequence of the cross with *G. tristis.* The beautiful crosses between *G. hirsutus*, *G. recurvus*, and *G. versicolor* are described as being more tender, not succeeding well in the open border. At p. 358 of the same work he remarks that "seedlings from the crosses between the scarlet *G. cardinalis* and the white or purplish *G. blandus* are always disposed to degenerate from the colour of the more brilliant parent, and approximate themselves to *G. blandus*, whether the scarlet *G. cardinalis* was the male or female ancestor. This seeming disposition in fertile crosses to produce seedlings approaching to the least splendid of their parents may arise from the effects of our climate being more congenial to the duller-coloured than the brighter species." *G. Colvillii* is a beautiful and fertile hybrid figured in Sweet's 'Flower Garden,' t. 155.

The beautiful *G. gandavensis* was obtained by M. Van Houtte in 1841, and appears to have been the result of a cross between *G. psittacinus* and *G. cardinalis*, and now lends its name to one race of varieties which originally descended from it by seminal variation, aided by cross-fecundation with other species, such as *G. floribundus*, *G. cardinalis* again, and the rosy-flowered *G. ramosus.* One of the first distinct varieties obtained after the production of *G. gandavensis* was *G. ganda-*

vensis citrinus, a yellowish form obtained by M. Lemonnier of Lille. A race of dwarf varieties (*Glaieuls nain*) was originated in the nursery of M. Van Houtte at Gand nearly twenty years ago, and these were obtained by crossing *G. cardinalis* with *G. venustus*, *G. trimaculatus*, a Cape plant, introduced in 1794, and *G. tristis*, a brownish-red-flowered species, also from the Cape, introduced in 1745. These forms are remarkable for their dwarf habit, and are in many cases richly spotted on the lower segments of the perianth, the shapes and colours of the

Hybrid Gladiolus.

flowers indeed being infinitely varied. The improvement of the Gladiolus seems to have been begun by Continental hybridisers between 1820 and 1830, and for some time it appears that the Continental and Dutch raisers had the improvement of this brilliant flower pretty much in their own hands. At the present time, however, Messrs Kelway & Son of Langport; Messrs Robertson & Galloway of Glasgow; Mr J. Douglas of Loxford Hall, Ilford; and the Rev. H. H. Dombrain, have

done, and are still doing, much to improve this, one of the finest of all autumnal flowers, and their new seedlings may be seen every season at the different metropolitan exhibitions.

The late Mr John Standish raised several very distinct kinds of seedling Gladioli, one of which was exhibited in 1871 under the name of "Alice Wilson," and figured in the 'Florist,' 1873, p. 73. The flower is rather small, creamy-white, edged with bright rose, the shape of the flower being open and regular, more like a Lily than a Gladiolus. It was one of a batch raised between *G. brenchleyensis* (raised by the late Mr Hooker of the Brenchley Nursery about thirty ago—its colour is a vivid scarlet) and *G. cruentus* (see 'Florist,' 1869, p. 121).

M. Max Leichtlin of Baden-Baden, a well-known scientific horticulturist, especially noted for his intelligent culture of Lilies, Irids, and other bulbs, thus writes on the improvement of Gladioli in the 'Garden,' vol. vii. (1875) p. 324: "When a certain race of hybrid plants is crossed and recrossed with its own varieties, the production of striking novelties becomes every year more difficult, until at last only one among many thousands is worth keeping, and that one is frequently but little better than others already in cultivation. We have nearly arrived at this point with Gladioli. The only way, so far as I can see, by which we can raise new and striking varieties, is to introduce, so to speak, new blood. Why not try some of those old and nearly forgotten species which were figured in the 'Botanical Magazine' some thirty or forty years ago? Why not try to obtain crosses between the Ghent varieties (*G. gandavensis*) and some robust species of recent introduction. It would not matter if kinds with a somewhat weaker constitution than that of *gandavensis* were used, for Nature likes to play her own part; and by crossing worn-out varieties with a fragile new species, the offspring is sometimes better and stronger than either of its parents. I do not advance any new theory; on the contrary, proofs of the correctness of my views are abundant, and within a year or two I hope to introduce to notice a new race of Gladioli of more graceful habit than those we now possess, and with flowers of different shapes and much larger than those of the *gandavensis* section, several of these flowers measuring as much as five inches across. This hint may be of service to Gladiolus raisers."

Among the old species above alluded to as being figured in the earlier numbers of the 'Botanical Magazine,' the following deserve the attention of hybridisers, together with *G. Saundersii*, *G. purpureo-auratus*, and other showy species of more modern introduction: *G. versicolor*, t. 1042; *G. angustus*, t. 602; *G.*

floribundus, t. 610; *G. Milleri*, t. 632; *G. blandus*, t. 625, 645, and 648; *G. undulatus*, t. 647; *G. viperatus*, t. 688. The last-named is a distinct lilac-purple green-spotted species, the flowers of which are perfumed.

G. alatus, t. 2608, salmon, rose, and yellow; this is a distinct species with orchid-looking flowers. *G. cuspidatus*, t. 582, a curious long-petalled flower; *G. carneus*, t. 591. Any one who turns over these plates and notes the glorious array of Ixias, Babianas, and other Irids which bear them company, will regret their absence from modern gardens.

Gladiolus communis, or common "corn-flag," is a most elegant rosy-flowered species (see 'Bot. Mag.,' t. 86). *G. cardinalis*, vivid scarlet, white rhomboidal spots. It is believed to come from the Cape (see 'Bot. Mag.,' t. 135).

Watsonia rosea.—This is a lovely rosy-flowered plant, having large blossoms like those of a Gladiolus, but quite regular. This plant, if it could be induced to cross with any seedling Gladioli, would give us a race similar to Mr Standish's "Alice Wilson," which I believe was the first variety with regular Crocus like flowers. (See also *W. rosea alba*, t. 1193; *W. meriana*, t. 1194; *W. humilis*, t. 1195.)

Iris.*—This is a large and beautiful genus of bulbous or rhizomatous plants, principally from Europe, North India, China, and Japan, some fine forms being also found in other temperate Asiatic countries. What a field is here open to the hybridiser! Here is a group of plants which every cottager may grow in his little front garden, and the flowers are as lovely as the Cattleyas from La Guayra or St Catherine's. We have already several fine races of seminal or cross-bred forms. *I. germanica*, the large purple-flowered "German Iris," has furnished a noble race of seminal forms, the flowers varying from dark purple and lilac to yellow and yellowish white. The "Spanish Iris," *I. xiphium*, has furnished us with many lovely and variably-coloured forms, as has also the "English Iris," *I. xiphioides*, and we hope to see these still further improved. It is interesting to know that the improvement of these races is quite possible in our own gardens; indeed the late Mr W. Masters of Canterbury raised many beautiful seedlings a number of years ago, and these at the time bore favourable comparison with the best Dutch varieties (see 'Trans. Hort. Soc.,' iii. 413). Hitherto the improvement of the three last-named races has been carried on by the Dutch florists, who have raised seedlings and supplied us with bulbs or rhizomes

* For a general review of the species of *Iris*, see 'Gardeners' Chronicle,' vol. for 1876.

during the past two or three centuries. Parkinson (see 'Paradisus,' 1625, p. 170, 189) describes and figures numerous species of Iris, including *I. susiana*, which were cultivated in his time. Of the "English Iris" he describes numerous forms, so that it must have been improved at a very early date. In speaking of these varieties he quaintly observes: "There hath been brought unto us divers roots of these kinds with the dried flowers remaining on them, wherein there hath been seen more varieties than I can well remember to expresse, which variety, it is very probable, hath risen by the sowing of the seeds, as is truly observed in the narrower-leaved kinde of Flowerdeluce, in the Tulipa, and in some other plants."

Iris Germanica a, Complete flowering plant, showing the petaloid styles, the rhizome, &c.; b, Transverse section of ovary.

It is curious to find that while the Dutch florists have sedulously gone to work to improve the European Iris, the Japanese gardeners have been equally industrious, and have long cultivated a race of extremely variable and beautiful forms of the purple, golden-rayed *I. lævigata* (see 'Bot. Mag.,' t. 6132) and *I. setosa* Pallas. These were first introduced into European gardens about 1873, I believe through the exertions of Max Leichtlin of Baden-Baden, and are now well known in our gardens under the name of *I. Kæmpferii*. They may be propagated by division and by means of seeds, which should be sown as soon as gathered, either in pots or

in the open ground, when they will vegetate the following spring. The first variety exhibited in this country was *I.* "E. G. Henderson" (see 'Florist,' 1874, p. 217), which startled horticulturists at South Kensington, in 1874 (see 'Gard. Chron.,' 1874, p. 45). This fine form had flat, regular, six-petalled flowers, five inches in diameter, of a rich purple colour, rayed with golden yellow, the form of the flower resembling that of a six-sepalled Clematis. A double-flowered form is alluded to by Kæmpfer, and numerous gorgeous forms are now grown in Continental gardens. *I. lævigata* is a native of N. Asia and Japan. *I. tectorum* (see 'Bot. Mag.,' t. 6118) is another fine Japanese plant, wild in the fields around Yokohama, and cultivated by the Japanese gardeners. It has regular six-rayed flowers like the last, and it seeds very freely. Its flowers are of a pale bluish-purple colour, spotted with dark purple, and having a cut crest, which peculiarity induced its discoverer, Dr Hance, to name it *I. tomiolopha* (see 'Jour. Bot.,' N.S., i. 229). This plant seeds freely, and may possibly be much improved. Like the last, it will be invaluable to the hybridiser. Mr Baker considers that *Iris spectabilis* (see 'Ann. Sc. Nat.' vol. v. p. 93) is a hybrid between *I. vulgaris* and *I. latifolium.* The same hybridist has raised a beautiful Iris —a hybrid between *I. susiana* and *I. iberica*—with flowers as large as those of the former; but the colour is intermediate, and the plant bears seeds freely. A hybrid obtained by the same grower between *I. susiana* and *I. germanica* bore dull magenta-coloured flowers, and was quite destitute of anthers.

Tigridia (*Tiger Iris*).—A small group of very handsome flowering bulbs, natives of Mexico, and represented in cultivation by *T. pavonia* (and its seminal forms, such as *T. pavonia Wheelerii*, *T. pavonia splendens*, and others) and *T. conchiflora*, which is little more than a native variety of *T. pavonia*, with which it crosses freely as the male parent. *T. aurantiaca* is a hybrid or cross-bred offspring, obtained by M. Goudet of Toulouse from seeds of *T. conchiflora*, which had been vivified with pollen from *T. pavonia*. This hybrid bears fertile seeds, but very rarely, most of the seeds being imperfect; nevertheless some have been found to vegetate and produce plants like the hybrid in every way (see 'Annales de Flore et Pomme,' 1839-40, p. 26). In 1840 another Continental horticulturist obtained two beautiful new varieties—viz., *T. speciosa* and *T. intermedia*; and two other distinct forms, *T. coccinea* and *T. Herbertii*, are also said to be hybrids. *T.* (*Marica*) *cœlestis* is said by M. Lecoq (see 'La Fecondation et de l' Hybridation,' p. 375) to bear an abundance of fertile seeds when fertilised with its own

pollen, and it might possibly be crossed with some of the varieties of *T. pavonia*, and a new race thus produced. Tigridias are readily multiplied by seeds sown in a well-drained pot or box of light sandy earth, and placed on the shelf of a warm greenhouse or frame to vegetate. Sow the seeds as soon as ripe, and plant out the spring following. The seedlings flower the second year.

THE WALNUT FAMILY (*Juglandaceæ*).

A small group of North American or Asiatic trees, represented in our gardens by *Juglans regia* or Common Walnut, *Carya* or North American and Chinese Hickory Nuts, and *Fortunea chinensis*, a tolerably well-known ornamental tree. In Cashmere and Persia the Walnut is extensively cultivated, and an excellent oil is there expressed from its nuts. There are numerous seminal forms of the Common Walnut, which vary not only in the size of the fruit, thickness of the shell, time of ripening, flavour, &c., but also in habit of growth. One variety of the Walnut common in Continental gardens fruits freely when only three or four feet in height. A distinct form (*Juglans laciniata variegata*) was raised in the garden of the Museum at Paris from seed of *J. regia laciniata*. The leaves, and occasionally the bark of the branches, are pleasingly variegated with yellowish white, which contrasts finely with the lively glistening green of the rest of the foliage. The variegation did not appear until about the second year of the growth of the plant. Walnuts are generally propagated from seed (nuts), sown as soon as ripe in the nursery-beds. A year or two ago, in the 'Revue Horticole,' M. André hints that his opinions as to the limits of species have undergone change since he has seen in the nurseries of the Paris Museum some trees of the White Walnut (*Juglans regia*) give birth to specimens almost identical with the American Walnut (*Juglans nigra*). A better plan to insure trees of any desirable variety is to propagate, by flute-grafting or budding in April or May, or by cleft-grafting in March and April: cleft-grafting at the forks of the young branches of the stock is also successful in March. M. Baltet recommends that "the scion should be cut as much as possible obliquely across the pith, so that it may be exposed on one side of the cutting only. A scion whose base consists of two-year-old wood will be found to answer well, and also one having a terminal bud. A stock worked near the ground should always have the soil heaped

around it as high as the uppermost bud on the graft. Never graft early-growing kinds on those of later vegetation. The varieties of American Walnut or Hickory Nut may be grafted

Juglans regia, W. (Walnut) a, Fruiting branch; b, Amentum of male flowers; c, Male flowers; d, Female flowers; e, Longitudinal section of a female flower; f, Longitudinal, and g, transverse, sections of the fruit

on stocks of their own type. We have grafted the European Walnut on the clefts of the young branches of the American as tall standards." Fresh, vigorous, young seedling Walnuts form the best stocks for desirable kinds of the Common Walnut,

and may be either worked by cleft-grafting on the collar of the root, or at standard height, by flute or fork grafting; in the latter case a scion having a terminal bud is best.

The Pond-Weed Family (*Juncaginaceæ*).

A small group of marshy or aquatic plants, principally natives of Europe, Asia, the Cape of Good Hope, North and Central America. They are represented in our gardens by the Northern Pond-Weeds—*Potamogeton*, the Cape *Aponogeton*, and the Lattice-leaf of Madagascar, *Ouvirandra.* The last-named is one of the most interesting and curious of all dwarf-growing stove aquatics, just as the Cape Pond-Weed *Aponogeton* is one of the prettiest and most fragrant of hardy plants. Seeds are ripened very freely on the *Ouvirandra* when thoroughly-established specimens, and these, if allowed to ripen and fall into the tepid water of the tank or bell-glass, ultimately sink to the surface of the soil or mud and germinate readily. This plan of self-seeding also takes place wherever the *Aponogeton* luxuriates in a shallow pond margin or ditch out of doors, or indoors in the conservatory aquarium. There are two or three distinct forms of this plant—the major and minor varieties being most distinct—in cultivation in a shallow ditch of clear running water in a nursery at Tooting, and hundreds of healthy little seedling plants line the sides of the shallow stream, while the older plants flower all through the mild winter and spring months. In the gardens at Fota, Cork Harbour, *Aponogeton* is naturalised in the pond, and thousands of seedlings spring up naturally, and these flower very freely and keep up a succession of bloom. Careful division may be resorted to in the case of *Aponogeton* or *Potamogeton*, care being taken to keep the divided portions moist; and they must be returned to their watery element as rapidly as possible, so as to increase the chances of success.

The Dead-Nettle Family (*Labiatæ*).

We have here a large group of annuals, herbaceous plants, or under-shrubs, principally natives of temperate countries, where they usually affect dry and airy situations rather than woods or marshes. They possess fragrant and aromatic qualities, Peppermint, Lavender-water, Patchouli, being familiar manufactured examples of their products. In our gardens they are represented by the ensuing genera: *Ocimum* (Basil),

Plectranthus, *Coleus*, *Lavandula*, *Perilla*, *Mentha* (Mint), *Salvia* (Sages), *Rosmarinus* (Rosemary), *Monarda*, *Origanum* (Marjoram), *Thymus* (Thyme), *Hyssopus* (Hyssop), *Melissa*, *Prunella*, *Scutellaria*, *Lamium* (Dead Nettles), *Leonurus*, *Caleopsis*, *Stachys*, *Marrubium*, *Ballota*, *Teucrium*, *Ajuga*, and many others. All the annual and many of the perennial Labiates are readily multiplied from seeds sown in the spring. Hardy kinds may be sown in the open-air beds, or in boxes of light soil in a cool frame. Seeds of the tender species should be sown in a gentle bottom-heat, either as soon as ripe or in February or March. In saving and gathering the seeds of these plants, it is necessary to observe that the seeds (nuts) are naked at the base of the persistent calyx; and unless harvested at the exact moment of their ripening, many will be lost. The herbaceous and perennial sections of the genus are generally readily multiplied by cuttings or by division of the roots. The curious structure of the floral envelopes and the stamens of *Salvia*, and many other Labiates, seems to indicate that insect agency is essential to their due fecundation: notwithstanding this hint, however, but little has been done by hybridists in improving these plants.

Coleus.—A genus of annual or perennial labiates, natives of both Asia and Africa. They strike very freely from cuttings of the young shoots in spring; and seeds, which are freely produced by *C. Verschaffeltii* and its varieties, grow readily in a genial bottom-heat, if sown as soon as ripe. Previous to 1868, these plants were represented in our gardens by about half-a-dozen species, including *C. Blumei*, a native of Java ('Bot. Mag.,' t. 4754); *C. fruticosus*, a well-known old plant from the Cape, often seen in London grown as a pot-plant in windows; *C. Macræi*, a native of Ceylon ('Bot. Mag.,' t. 4690); *C. inflatus* ('Bot. Mag.,' t. 5236); *C. Verschaffeltii*, *C. Gibsonii*, *C. Veitchii*, and one or two others; while at the present time the varieties are too numerous to mention. In 1867 Mr F. Bause, then propagator in the Royal Horticultural Society's garden at Chiswick, commenced hybridising *C. Blumei* and the three last-mentioned species, the results being remarkably successful. *C. Verschaffeltii* was made the seed-bearing parent throughout, simply because the other kinds do not readily supply seed. The following twelve varieties among many others were selected, and sold at Stevens's Rooms by public auction: they realised upwards of £390. They have been placed by Mr T. Moore into two classes, one group having the plano-crenate leaves of *C. Veitchii*, while the others have inciso-dentate frilled foliage, as in *C. Verschaffeltii*.

PLANE-LEAVED SERIES.

C. Berkeleyii	(*C. Verschaffeltii* × *C. Veitchii*).
C. Marshallii	(*C. Verschaffeltii* × *C. Veitchii*).
C. Saundersii	(*C. Verschaffeltii* × *C. Veitchii*).
C. Dixii	(*C. Verschaffeltii* × *C. Veitchii*).
C. Ruckerii	(*C. Verschaffeltii* × *C. Gibsonii*).
C. Murrayii	(*C. Verschaffeltii* × *C. Gibsonii*).

FRILLED-LEAVED SERIES.

C. Bausei	(*C. Verschaffeltii* × *C. Veitchii*).
C. Scotii	(*C. Verschaffeltii* × *C. Gibsonii*).
C. Clarkei	(*C. Verschaffeltii* × *C. Gibsonii*).
C. Batemanii	(*C. Verschaffeltii* × *C. Gibsonii*).
C. Wilsonii	(*C. Verschaffeltii* × *C. Veitchii*).
C. Reevesii	(*C. Verschaffeltii* × *C. Blumei*).

In a few months after these varieties were distributed, Mr W. Bull, Messrs E. G. Henderson & Sons, and other cultivators, succeeded in raising other distinct forms; and subsequently Mr Bause originated a second series, this time with very brightly-coloured foliage, one of the best, *C.* "Queen Victoria," having bright carmine-purple leaves, bordered irregularly with golden yellow (see 'Florist,' 1869, p. 1). The next distinct variety was *C. Telfordii*, a sport from *C. Blumei;* and then Coleuses became too common, and are now rarely grown, if we except *C. Verschaffeltii* and an improved form of it, which are found to be the best for outdoor decorative purposes. The finest of all the forms yet raised, however, is *C.* "Duchess of Edinburgh," a variety of American origin, sent out by Messrs Carter & Co. in 1875. It has a flat carmine-purple crenate leaf, edged with yellow, and is a decided improvement on "Queen Victoria." We now wonder how it was that such extraordinary prices were paid for Mr Bause's seedlings, but then they were such a decided improvement on existing kinds; and although the Coleus mania is over, large sums would still be paid for any distinct class of new hybrids of any less common plant. In 1871, Messrs E. G. Henderson & Sons exhibited a hybrid Coleus, named *C.* "Emperor Napoleon," which they had obtained as the result of crossing *C. Berkeleyii* with the old "Nettle Geranium" (*Plectranthus fruticosus*), in order if possible to obtain a race of hardier kinds. Some of the seedlings from this union showed a partial return to one or other of the parent plants. *C.* "Lady Burrell," sent out by Mr Cannell in 1874-75, is one of the most distinct, the basal half of the leaf being of a deep crimson maroon, while the apical half is golden yellow, the line of demarcation being as clear as if painted.

It does not appear to be sufficiently well known that all the choice and comparatively tender varieties of fine-foliaged Coleus may be grafted on [illegible] cuttings of *C. Verschaffeltii* as a stock. Side-grafting [illegible] is the best method and the grafts should be surrounded by a bit of oiled silk, and then tied with soft budding cotton. A bit of bladder will do as well as the silk, but something is needed to prevent the tie cutting the succulent base of the grafted cutting or scion.

True Laurel Family (*Lauraceæ*).

A group of trees or shrubs inhabiting the cooler parts of the tropics, North America, and represented in Europe by the true Laurel of the poets (*Laurus nobilis*). Nearly all the plants of this order contain fragrant oil, and the camphor of commerce is obtained from the wood and leaves of *Camphora officinarum*, the main supply being obtained in Formosa, whence it is sent to Canton for sale to foreign markets. Cinnamon of the shops is the produce of *Cinnamomum zeylanicum* and other allied species. The plants in this group are propagated by seeds, which germinate readily in a moist bottom-heat of 65° to 75°, and cuttings of the young or partially-hardened growth are also successful in a close case. Cuttings of the roots are found useful in increasing many species which are cultivated in the tropics, and layering is a sure method which rarely fails. In the case of the true Laurel, hillock-layering is most successful, although a fair proportion of cuttings may be rooted on a north border if inserted in October, or even earlier. Seeds may also be employed wherever obtainable. In the south and south-western counties the Laurel fruits very freely; and at Battle Abbey the plant is thoroughly naturalised, and reproduces itself from self-sown berries every year.

The Butterwort Family (*Lentibulariaceæ*).

A small group of insect-catching plants, represented in our gardens by *Utricularia* and *Pinguicula*, natives of bogs, marshes, or rivulets, in nearly all parts of the world, but principally in the tropics. Both the genera above cited are represented in the English flora. *Utricularia alpina* bears very showy white flowers, the closed lips and long spur of which remind one of some Linarias. *Pinguicula grandiflora* is a very beautiful plant found near Killarney. The Utricularias are

readily increased by dividing the bladder-like vesicles, or by taking off the offsets which are spontaneously produced. The Pinguiculas seed freely, and the seeds germinate very readily on any moist surface, and often appear in large quantities from self-sown seed, in the cool pit or frame where the plants have been grown.

The Lily Family (*Liliaceæ*).

Some of the most beautiful of all bulbous plants are included in this order, the true Lilies being perhaps the most ornamental from a cultivator's point of view, being represented in our gardens by some forty or fifty species, and numerous forms all more or less beautiful. Naturally they are distributed widely in South Europe, North America and California, Japan, and on the mountains of North and South India. The most useful Lily-worts are the Alliums. *A. ascalonicum*, or Shallot, was brought from Palestine before 1546. *A. cepa*, the Onion, has long been cultivated, and its native country, like that of many other ancient food-plants, is unknown, but it probably originated in the East. *A. fistulosum*, or Welsh Onion, is a native of Siberia, and was introduced prior to 1629. *A. porrum*, the Leek, is a Swiss plant, first grown in this country about 1562. *A. schœnoprasum*, or Chives, is a British plant. *A. sativum*, Garlic, was introduced from Sicily before 1548; while *A. scorodoprasum*, Rocambole, is a native of Denmark, introduced before 1596. Dr Royle is of opinion that the Leeks, Garlic, and Onion of to-day are the same plants mentioned in the Bible under their respective names (Num. xi. 5). Tulips, Fritillarias, Scillas, Ornithogalums, &c., are widely distributed in Europe. Yuccas are principally American; Aloes come principally from the Cape; and the Hyacinth seems to have been introduced from the Levant previous to 1529. Nearly all Liliaceous plants seed freely; others produce little bulbils on the flower-stem, instead of bearing seed (ex. Potato-Onion), and others are readily multiplied by dividing the bulbs or offsets. All the robust-growing Lilies, with thick scaly bulbs, may be propagated by stripping off the scales carefully, and planting them for cuttings, as is done with Echeveria leaves. Sow the seeds of tender species in a gentle bottom-heat as soon as gathered, or in the spring. The seeds of hardy species may be sown in the open air in March or April. The rarer kinds, however, are best sown in pans placed in a cool frame. All the ornamental species of Lily-worts having bulbous or fascicled

roots are readily propagated either by offsets, division, or by seeds, sowing the tender species in a gentle bottom-heat of 60° to 70°; while the hardy kinds may either be sown as soon as ripe in pans of light rich earth, and placed in a frame, or sown in nursery beds in the spring. To this group belongs *Erythronium* (Dog's-tooth Violet), *Tulip*, *Calochortus*, *Cyclobothra*, *Fritillaria*, *Lilium*, *Gloriosa*, *Hemerocallis*, *Funkia*, *Agapanthus*, *Polianthes* (*Tuberose*), *Blandfordia*, *Velthemia*, *Tritoma* (Red-hot Poker), *Phormium*, *Sansevieria*, *Aloe*, *Lomatophyllum*, *Yucca*, *Allium*, *Scilla*, *Ornithogalum*, *Albuca*, *Muscari*, *Hyacinthus*, *Puschkinia*, *Leucocoryne*, *Brodiæa*, *Triteleia*, *Lachenalia*, *Eucomis*, *Cyanella*, *Anthericum*, *Arthropodium*, *Chlorophyton*, *Dianella*, *Asparagus*, *Cordyline*, *Dracæna*, *Polygonatum*, *Convallaria*, *Ruscus*, *Aspidestra*, and *Ophiopogon*.

Asparagus.—Apart from the Alliaceous or Onion tribe of *Liliaceæ*, *Asparagus* is one of the most valuable of all the esculent Lilies of our gardens, and is readily propagated by seed. The cultivated forms of Asparagus have nearly all originated by culture from *A. officinalis*, a weed on the Cornish, Devonshire, and Hampshire coasts, and all round the Mediterranean. We have several very distinct seminal and selected cultural forms of Asparagus, all exceeding the common kind in size but not in flavour. Among these the *Argenteuil*, or Early Purple Giant, as it is sometimes called, and Lenormand's "French Colossal," are much grown in French gardens. Conover's Colossal is an American variety, also of large size; while one called Grayson's "Covent Garden Giant" is most prized by the London market-gardeners. Several species of Asparagus from South Africa are elegant foliage-plants.

Agapanthus (*Love-flower*).—Half-hardy Liliaceous plants, found in moist situations in Southern Africa, and represented in our gardens by two or three varieties of *A. umbellatus*. The roots are thick and fleshy, and produce tufted clusters of strap-shaped leaves, and tall scapes, terminated by an umbel of blue or white campanulate flowers. Seeds are rarely produced in cultivation, unless the plant is grown in the greenhouse, and the flowers are artificially fertilised. Seeds so obtained, sown as soon as ripe in shallow pans or boxes of moist sandy compost, and placed in a genial temperature of 50° to 60°, germinate readily, and soon form strong plants if potted off into a rich compost. The usual plan of propagation, however, is to divide strong clumps or masses just before the plants commence to grow in spring. There are already several cultural or seminal forms of *Agapanthus*, one of which, *A. Mooreii*, is much dwarfer, with narrower and more rigid leaves than the type, and similar

umbellate clusters of blue flowers. Two distinct forms of *A. umbellatus* bearing blue flowers, and the white and variegated leaved forms, are grown at Kew.

Allium (*Onions*).—A genus of Liliaceous bulbs, with grass-like fistulous or hollow leaves, and very pungent odour. The best-known cultivated kinds are *A. cepa* (Common Onion), and its variety, the Potato-Onion, which produces a cluster of offsets around the parent bulb, and not unfrequently bulbils on the summit of the flower-stem. Other species grown largely for culinary uses are *A. sativum* (Garlic), *A. ascalonicum* (Shallot), *A. porrum* (Leek), and *A. fistulosum* (Welsh Onion). Of these, the Leek and Common Onion are most generally grown, and are propagated from seeds which are produced the second year, so that these are biennial in our climate. Garlic, Shallots, Potato-Onions, and Rocambole (*A. scorodoprasum*), being perennials, are readily increased by offsets or "chives," as they are technically called. It is not usual to grow Shallots, Garlic, and Rocambole from seed, but the practice is very successfully followed by Mr Trigg of Hayling. His plan is to plant out the offsets in the usual manner, and allow them to seed. The seed is sown in good rich soil, at the same time as Onion seed, and the crop is such that five fair average specimens weigh 1 lb. 7 oz. They at first look like Onions, but when they begin to divide into offsets the peculiar difference between the two is readily distinguished. This method of growing Shallots is by far the best for a large supply, and is the plan adopted in Jersey and Guernsey for procuring the enormous quantities sent every year to Covent Garden Market. All are plants of high antiquity, having been used as food from time immemorial. The Common Onion is largely cultivated in the neighbourhood of Sandy, in Bedfordshire, and large quantities of Onion seed are saved there every season. Well-formed sound bulbs are selected and planted in the spring in rows, which vary from two to five or six feet apart, Lettuce or other small crops being often grown between the rows. As the flower-stems become developed, they are staked, and twine or cord is strained on either side the rows, to prevent the stems being beaten down by hail, rain, or wind. Onion seed is generally sown in March or April—Tripoli Onions, hardy varieties, in July or August.

The types of cultivated Onions are: White Spanish, Brown Spanish, Blood Red, Bulbiferous or Potato Onion, Tripoli (red and white varieties), Strasburg, and New German. The Onion is one of the oldest of all cultivated vegetables; but, as is the case with Wheat, the Vine, and many other valuable plants, its origin is lost in the obscurity of bygone ages.

Aloe.—A genus of succulent Liliaceous plants from the Cape of Good Hope. They must not be confounded with the species of Agave, or American Aloes, as they are popularly and erroneously called—greenhouse plants, easily propagated from stem-cuttings, offsets, or seeds sown in a gentle heat of 60° to 70°. To secure seeds, it is generally necessary to cross-fertilise the flowers. They are nearly related to *Gasteria*, *Haworthia*, &c.; and some curious hybrids might possibly be obtained between these genera. Economically they are valuable, one or two species producing a useful medicinal drug. Hybrid Aloes have been raised by Mr R. J. Lynch, the parents being *A. albocincta* and *A. grandidentata*.

Blandfordia.—A handsome group of Australian Lilyworts, with grassy or sedge-like leaves and erect spikes of drooping orange-scarlet or yellow bell-shaped flowers. *B. marginata*, *B. nobilis*, *B. grandiflora*, and *B. Cunninghamii* are sometimes met with in cultivation as greenhouse plants, and are propagated either by dividing established plants or from seed. Singularly enough, the handsomest plant in the whole group is a hybrid, and this fact ought to lead cultivators to improve this genus still more by raising seedlings or by hybridising. Seeds germinate best sown as soon as ripe in a gentle bottom-heat of 60° to 70°, care being taken to drain the seed-pans thoroughly, as these, like most other half-tender Liliaceous seeds, are liable to suffer from damp.

B. flammea elegans is a very showy hybrid, obtained by intercrossing *B. flammea* and *B. Cunninghamii.* It was raised by Messrs E. G. Henderson & Son, of St John's Wood (see 'Floral Mag.,' 1874, t. 134).

Dracæna (*Dragon - Trees*).—Foliage - plants of noble habit from Australia, the South Sea Islands, and other tropical countries. The flowers are readily fertilised; and when this is the case, most species seed freely. Many variegated forms have been raised in English and Continental nurseries from home-grown seed. The flowers are borne on long-branched spikes, and the stamens contain a copious supply of pollen. After fertilisation, a one or two seeded berry or fruit is formed. The seeds should be sown in pots or pans of light sandy earth, and soon germinate if placed on a genial bottom-heat in a close case.

D. indivisa not unfrequently ripens an abundant crop of fertile seeds even in the open air, especially in Devon, Cornwall, and other sheltered counties in England and Ireland, and these open-air seeds are found to germinate very vigorously. The green-leaved forms are the hardiest, and of noble habit,

and seedlings or hybrids of these might prove to be improvements on existing varieties. Old plants of *D. congesta*, *D. fragrans*, *D. cannæfolia*, and others, flower very freely in a warm greenhouse temperature. The tall-growing species or varieties may be propagated by girdling the stem and surrounding the cut portion with damp moss or soil, into which roots are soon protruded, after which the top may be entirely removed and potted, while the stem below may be cut up into pieces of from 4 inches to 6 inches long, and these pieces being laid horizontally in a hotbed or a propagating pit, and covered with light soil, push out in a very short time numerous buds, one from above the scar of each leaf. These form young shoots, which, when an inch or two in length, are taken off with a little heel, and planted as cuttings in sandy earth. They are kept rather close, and under such conditions soon produce roots, and form independent plants.' The same mode of propagation may be adopted with any plants of similar habit. It is, in fact, often had recourse to in the case of Yuccas.

D. hybrida.—A very distinct seedling raised at the Chelsea Nursery, and the first hybrid offered to the public. It is a cross between *D. magnifica* and *D. albicans*. Plant of medium growth, with leaves averaging from 10 to 12 inches in length by 3 in breadth. They are of a deep green colour, and, as the plant attains age, become entirely suffused with deep rose and creamy white, the older leaves being margined with bright rose. The variegation shows itself whilst the plant is quite young, and from its graceful habit and beautiful colouring, it is exceedingly useful for decorative purposes.

D. Taylorii.—This is another of Messrs Veitch's seedlings, its parents being *D. Mooreana* and *D. magnifica*. It is very robust in habit, having vigorous dark bronzy foliage, and a more compact habit of growth than either of its parents.

At a meeting of the Royal Horticultural Society, November 10, 1875, Mr John Wills exhibited thirty-six new seedling Dracænas which had been raised by one of his foremen, Mr F. Bause, an intelligent propagator, who, when at Chiswick, electrified horticulturists by a new race of *Coleus*, these being followed by a still finer golden-variegated race, and a batch of very handsome golden-leaved *Caladiums*. It may interest hybridisers to know that the parents of these plants were hybridised, and the seedlings exhibited, in less than three years. The seeds were sown August 1, 1874, and the plants —some of them 2-3 feet in height—were exhibited on November 10, 1875. These new Dracænas were for the most part

half-breeds and crosses between such species and forms as *D. terminalis*, *Cooperii*, *regina*, *concinna*, *nigrescens*, *excelsa*, *ferrea*, *limbata*, and *Chelsonii*; and the number of seedlings raised was about 1700, from which the best thirty-six plants were selected, and these will be found described, with their parentage and other particulars, in the 'Gardeners' Chronicle,' 1875, p. 615. *E. regina* (which is by some considered a variegated form of *D. brasiliensis*) was the male or pollen parent in a large majority of cases. One of these seedlings (*D. Amaliæ*) was raised from seed of *D. congesta* (*paniculata*) fertilised with the pollen of *D. terminalis* and *D. regina* mixed. The experiments of Gaertner and Dean Herbert show that mixed pollen does not act collectively, and the law of elective affinity goes to prove that the ovules become fecundated by the pollen of that species which possesses the greatest sympathy or consanguinity with the plant fertilised, the other pollen mixed with it being inert or impotent.* We are not likely to arrive at any satisfactory conclusions as to the efficacy of mixed pollen in such a highly variable genus as *Dracæna* (*Calodracon*), since, as Mr James O'Brien, one of our most intelligent hybridists, has proved, many of the coloured-leaved forms of Dracæna produce numerous and very diverse varieties by simple seminal variation; and when a race of plants reaches this state of extreme variability, the most systematic cross-breeding is reduced to a state bordering on uncertainty, just as in the case of *Pelargonium* or *Calceolaria*. Many of the Dracænas imported from the South Sea Islands are merely accidental or cultural varieties, or, as Mr O'Brien puts it, "natural seedlings from plants which have become accidentally variegated" (see an account of Messrs E. G. Henderson's new seedling Dracænas in 'Belgique Horticole,' 1875, p. 282, 283). Messrs Henderson's seedlings were raised from *D. albicans* fecundated with pollen from *D. pulcherrima*, and seeds taken off the same panicle produced dwarf and tall-growing plants, some with erect, others with recurved, foliage; while in breadth and colour of leafage, nearly every phase of variation was presented.

Fritillaria (*Checkered Flowers, or Snake's Head; Crown Imperials*).—A genus of bulbs, mostly European, and nearly related to the true Lilies, like which they are readily propagated by division, offsets, or seeds. There are some twenty or thirty species, and some of those not yet introduced are very pretty.

* "The sole effect of mingling two kinds of pollen is to produce in the same capsule seeds which yield plants, some taking after the one and some after the other male parent."—Darwin.

It is curious to observe that at the base of each petaloid segment of the flower is a little pit or depression filled with a viscid fluid, which may be found to be an aid to the fertilisation of these plants. In *F. imperialis*, "Crown Imperial," this fluid shines with a beautiful pearl-like lustre. Little or nothing appears to have been done to improve the plants in this genus; but some of the species belonging to the solitary-flowered or *F. meleagris* section are certainly among the most graceful, from an artistic point of view, of all hardy bulbs. The prevailing colours are purple, brown, yellow, white, and green. Careful hybridisation might give very distinct races of these elegant flowering bulbs. *F. oxypetala*, a purple-flowered Indian species, is now referred to the genus Lilium, while the plant known as *Lilium giganteum* and its ally *L. cordifolium* are by some referred to Fritillaria. *F. oxypetala* certainly looks intermediate, and it would be interesting to attempt to hybridise some of the Fritillarias with the Lilies which most nearly approach them in structure and affinity. I am convinced that the gardener can assist the botanist very materially in the matter of determining genera by careful experiments in hybridising.

Hyacinthus (*Hyacinths*).—A genus of showy bulbs, represented in our gardens by innumerable seminal forms of *H. orientalis* (see 'Bot. Mag.,' t. 937), which appears to have been introduced to our gardens from the Levant prior to 1596, as it is mentioned by both Gerarde and Parkinson, and the last-named author figures several varieties at p. 121 of his 'Paradisus' (1629). The oriental Hyacinth varies in colour through all the shades of white and creamy yellow to blue, purple, lilac, rose, and magenta. Seedlings from good varieties produce a fair percentage of novel forms, and the best of these are then propagated by dividing the bulbs. *H. romanus* (*H. italicus*) is the early Roman Hyacinth, which is often forced for cut-flowers before the varieties of *H. orientalis* commence to bloom. New varieties of Hyacinths have long been originated by the Dutch florists, and this favourite flower, and the Tulip, Narcissus, Anemone, Iris, Crocus, &c., are popularly known as "Dutch bulbs," these being chiefly cultivated near Haarlem and Lisse, and owe their superiority as much to the suitable texture and position of the soil—a calcareous sand resting on peat—as to the lavish use of manure. An area of 125 acres devoted to Hyacinth-growing near Haarlem, is estimated to bring in a revenue of nearly £30,000. In 1859, bulbs were exported to the value of £12,700; and in 1862 the village of Bloemendaal, "the Valley of Flowers," sent forth

no less than £200,000 worth. Where bulb-culture is the main object of attention, the routine is frequently as follows: First year—The soil is broken up and dug to a depth of five or six inches, a heavy dressing of cow-dung is applied, and a crop of potatoes taken. In the autumn the bulbs are planted, and the beds remain covered with reeds until the month of May. Second year—About midsummer, the bulbs having been collected, grass is sown on the paths between the beds, and in the autumn Tulips, Crocuses, and occasionally different kinds of Narcissus and Ranunculus, are planted on the greensward.

Lilium (*True Lilies*).—We have here the noblest of all hardy bulbous plants, and fortunately they are readily propagated from seeds or by dividing the bulbs, and it is a little singular to find that the Japanese gardeners have been before us in the matter of cultivating and improving Lilies, just as they have been with Peonies, Chrysanthemums, and many other popular garden flowers.

We have now nearly the whole of the known species of Lilium, as described by Mr J. G. Baker (see 'Gardeners' Chronicle,' 1874, p. 104—1651), in our gardens, and for practical purposes they may be divided geographically into four sections, thus:—

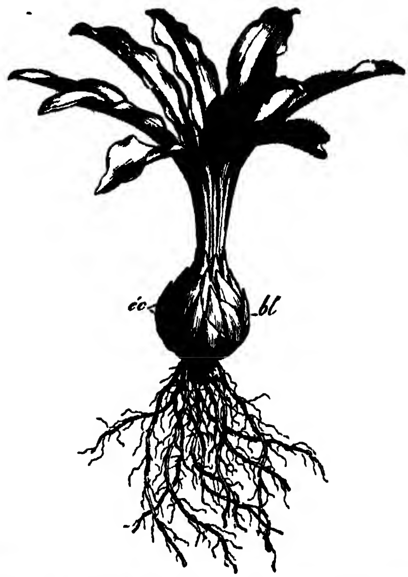
European	American	Japanese	Indian
L. martagon. *L. aurantium.* *L. tenuifolium,* and others, and many seminal or hybrid forms.	*L. canadense* *L. Humboldtii.* *L. philadelphicum,* and many seminal or hybrid forms.	*L. Thunbergianum* *L. japonicum.* *L. speciosum.* *L. auratum.* *L. eximium,* and many intermediate forms	*L. longiflorum* *L. nepalense* *L. Wallichianum* *L. giganteum.* *L. cordifolium,* &c

Most of the species and varieties may be propagated more quickly by scale-cuttings than by seed. The scales are either pulled carefully asunder or are cut away from the bulb, beginning at the base first, and cutting a little piece of the core or heart of the bulb away also when practicable. These scales are then inserted in pans or boxes of light sandy earth, being just covered and no more, and are then placed in a cold frame or pit for a week or two, and kept only just moist. They may then be removed to a higher temperature, and soon develop little bulbils at the base of each scale, as shown in our

engraving. Seeds of *L. auratum*, *L. speciosum*, and other hardy kinds, may be sown in spring on open-air beds, raised slightly above the general ground-level so as to avoid damp.

What a field of improvement is here open to the skilful hybridiser! Hardy flowers with the substance and purity of colour of the finest tropical Orchids, plenty of fertile pollen, and seeds

Lily-scale, producing bulbils.



Scaly bulb of the White Lily (Lilium candidum), with the tuft of leaves which it produces bl, The bulb itself; ec, Scales which it forms.

that grow readily,—what can a cross-breeder want more? Well, everything looks fair enough, but the truth is that hybridising Lilies is up-hill work, as the seedlings, although the result of careful hybridism, either resemble the male or the female parent.* Still hybrids, and very beautiful ones too, have been obtained. Of nearly all the species there are varieties, and this seems especially the case with *L. martagon*, of which Parkinson describes and figures several forms in 1629. Nearly all the

* Mr Parkman's experience in hybridising Lilies goes to prove that *L. speciosum* may be fertilised with pollen of *L. auratum*. Nevertheless the seedlings which result from this union are in nearly every instance exactly like the female parent. *L. Parkmannii* was the only intermediate he succeeded in obtaining after several years' labour.

Japanese and American kinds also show traces either of former culture or natural cross-breeding. Not a little has already been done by cultivators and botanists in obtaining hybrids and seminal forms of Lilium.

Among the first hybrids offered for sale in this country appear to be varieties obtained by blending *L. bulbiferum* and *L. atrosanguineum* (a variety of *L. elegans* = *L. Thunbergianum*, Hort.) These were sent out from Mr Groom's nursery at Walworth, and are thus described in Glenny's 'Garden Almanack:'—

"Duke of Wellington, about 16 inches high; bright rich red colour, with a few dark-red blotches; a fine rich kind, producing from ten to fourteen flowers on a stem. Nabob, about 22 inches high; bright orange, with very dark blood-coloured blotches; a very fine kind, producing from twelve to sixteen flowers on each stem. Voltaire, about 13 inches high; light orange with red-brown blotches; the best of the light coloured sorts; produces from twelve to sixteen flowers on a stem. Louis Philippe, about 26 inches high; very bright deep red, with a few blotches and black spots, producing from sixteen to twenty flowers on a stem; an extra fine kind. Rubens, about 17 inches high; rich dark red, with a few blotches and some black spots; produces from ten to fourteen flowers on a stem. Titian, 15 inches high; red orange with a few dark spots; free bloomer, producing from sixteen to twenty flowers on a stem; a very handsome variety. Duke of Devonshire. about 13 inches high; lightish-red and dark-red blotches; a fine kind, and free bloomer. Duke of Sutherland, about 16 inches high; bright red colour, lightly blotched; a fine flower, producing from twelve to sixteen flowers on a stem. Napoleon, about 18 inches high; light red, light blotches; a very free bloomer, and fine flower. Marshal Soult, about 14 inches high; bright red, and fine dark blotches, producing from twelve to sixteen flowers on a stem; an extra fine sort. Don Juan, about 17 inches high; light red with blotches; a good flower, producing from ten to fourteen flowers on a stem. Sappho, about 16 inches high; fine dark-red colour, well blotched with dark blood colour; a free bloomer, and an extra fine flower."

Mr Groom seems to have been one of the most enlightened florists of his time, for prior to 1847 he had raised numerous seminal forms of *L. speciosum*—a now well-known plant, but then comparatively new, having been introduced from Japan in 1833. These varieties were described in the gardening periodicals at the time as varying from pure white to deep rosy crimson, variously spotted, just as we find the case in seedlings

from *L. auratum* in our own day. It is the more remarkable to find that Mr Groom grew his *L. speciosum* varieties in the open air, and so obtained results but rarely equalled by greenhouse or pot culture. In 1850, we find Messrs E. G. Henderson & Sons had a houseful of the seminal varieties of *L. speciosum*.

In the 'American Gardeners' Monthly,' 1868, Mr Wilder records some of his experiments in crossing Japanese Lilies. He asserts that he has crossed *L. lancifolium* with the pollen of *L. tigrinum;* and he remarks that *L. auratum* is fertilised with difficulty by its own pollen, or with that of *L. tigrinum*, while it is quite possible with pollen of *L. lancifolium*.

The Prussian botanist, Maximowicz, also obtained intermediate forms between *L. davuricum* and *L. bulbiferum*—his object, however, being rather to observe certain points in the action of foreign pollen than to obtain beautiful new forms of garden plants. An account of his experiments may be found in 'Jour. Royal Hort. Soc.,' vol. iii. (New Series), p. 161.

In the gardens of China, and especially in Japan, are innumerable beautiful seedling varieties, some of which have been introduced to this country, apparently in many cases hybrids between *L. auratum*, *L. speciosum*, and *L. longiflorum*. *Lilium Parkmannii* is a large and beautiful hybrid raised by Mr Parkman, an American cultivator, and by him sent to Mr Waterer of Knaphill. The entire plant is 2-3 feet in height, its stem being clothed with alternate ovate-nerved leaves, and each bearing one erect flower fully 8 inches across as reflexed, the total width with the segments stretched out being 13¾ inches. The three inner segments are fully 4 inches in width. The segments are white, their lower halves being suffused with rose, and studded with deep crimson spots and papillæ. The style is green, and the pollen chocolate-coloured. This fine plant is the result of a cross between *L. auratum* and *L. speciosum* (see 'Gardeners' Chronicle,' 1875, p. 237, 366, and 494, with full-sized woodcut figure).

Several other hybrids have been raised in English gardens between *L. auratum* and *L. speciosum*, one of which, a very chaste and beautiful variety, named *L.* "Purity," was exhibited by the raiser, Mr G. Thomson, at South Kensington in 1870.

L. testaceum is supposed to be a hybrid, and its history may be found in 'Flore des Serres,' vol. i., its assumed parents being *L. candidum* and *L. chalcedonicum*.

L. (*hybridum*) *Kramerii* is a handsome Japanese plant, by some supposed to be a hybrid between *L. speciosum* and *L. japonicum* (see 'Flore des Serres,' 1874, p. 31, t. 2061-62):

others consider *L. longiflorum* and *L. auratum* to be the parents (see 'Flor. Mag.,' 1874, t. 195, and 'Bot. Mag.,' 1874, t. 6058).

The Hon. Marshall P. Wilder (see 'Gard. Chron.,' 1873, p. 575), in his address to the Massachusetts Horticultural Society, Feb. 7th, 1872, remarks: "About thirty years ago, on the introduction of the Japan Lily, just then discovered by Dr Van Siebold, I commenced hybridising it with other species. My first experiment was the crossing the red variety (*L. lancifolium rubrum*) with the Tiger Lily (*L. tigrinum*). From this cross were produced seedlings of different shades, from delicate rose to dark crimsom. When my first Japan Lily, the *Lilium lancifolium speciosum*, was coming into bloom in 1837, I procured from an adjacent garden pollen from the common Tiger Lily, and preserved it for several days in my vest-pocket. It was then used in impregnating the Japan Lily, and from this cross came the first seedlings of this plant. During the last thirty years I have crossed the Japan Lily with various other species of the Lily tribe, and have produced some fine varieties, as have my friends Mr Parkman and Mr Honey, from whom we hope to hear in the course of our lectures in regard to their interesting and successful experiments in hybridising these and other plants. Among the most remarkable of my experiments has been the crossing of *L. lancifolium rubrum* with *Gloriosa superba*, the seedlings from this hybrid being now in growth. I have also crosses of different species of the Lily genus, which have produced singular variations, one of which is a flower with two rows of petals."

The cross alluded to above between the climbing Lily-like *Gloriosa* and *L. lancifolium* is highly interesting, and we hope our American friends will let us have full particulars of the seedlings.

Tulipa (*Tulips*).—The Tulip is one of the earliest of all "florists' flowers," and Parkinson figures several varieties which were popular in London gardens in 1629; while at a later period "Tulipomania" spread throughout Holland and Belgium, and other countries of Europe, and the prices realised for bulbs of notable new varieties frequently exceeded that now paid for the rarest of tropical Orchids. There are numerous species, mostly natives of Europe, the florists' varieties having originated from *T. Gesneriana* (striped), introduced from the Levant in 1577, and *T. suaveolens*, a red-and-yellow sweet-scented S. European species, first cultivated in English gardens about 1603. The varieties which have originated from the last-named plant are less gorgeous in colouring than the

seminal forms of Gesner's Tulips, but they possess the advantages of earliness and perfume. There is a wide field for the intelligent skill of the hybridiser in this genus, but in order to effect some startling changes we must cross distinct species with the finest of existing varieties, or, better still, with other species possessing distinct and desirable characteristics. *T. Celsiana* crossed with *T. sylvestris* might, as suggested by M. Lecoq, give some charming yellow-flowered hybrids; or by raising seminal forms or hybrids from *T. cornuta*, we might obtain some elegant flowers—a distinct race of long, narrow-petalled flowers, which would be valuable for decorative purposes, and somewhat analogous to the Japanese race of Chrysanthemum. The two or three species having a yellow-edged blotch on their petals, of which the spotted-leaved *T. Greigii* (Caucasus) (see 'Bot. Mag.,' t. 6177) is the type, might also furnish a race if intercrossed either with themselves or with other species or varieties. The species of Tulip do not receive that cultural attention in our gardens which they deserve. Nearly all the species supply pollen copiously and seed freely. Gather the seed just before the pods burst, and hang them in a cool dry shed until the spring (February), when sow in boxes or pans of light rich soil in a gentle heat. Plant out the seedlings in June in prepared beds of rich well-drained soil, where they can remain until they bloom. The Dutch florists raise hundreds of seedling Tulips annually, but, singularly enough, they keep plodding on with the forms of *T. Gesneriana* and *T. suaveolens*, instead of cross-breeding with some of the other distinct species, so as to originate new and more beautiful races.

Tulipa sylvestris is figured in the 'Bot. Mag.,' t. 1202; *T. stellata*, t. 2762; *T. suaveolens*, t. 839; and *T. Breyniana*, t. 717. The last is a Cape species, introduced in 1787.

Tulipa Clusiana (see 'Bot. Mag.,' t. 1390) is an old, slender-growing, white-flowered species, the outer segments being feathered with purple behind, and the flower is improved by a deep-purple eye. Native of Sicily.

Yucca.—A very distinct and beautiful genus of hardy and half-hardy evergreen caulescent Lilyworts, principally from the N. and S. American states. They rarely produce perfect seed in this country, but imported seeds germinate freely in a genial bottom-heat, after which they should be hardened off and planted out in nursery beds when sufficiently advanced in size. Seeds germinate in a few weeks after they are sown, but the young plants are of rather slow growth. The caulescent species may be multiplied by dividing the stem so as to retain a latent

eye or bud to each portion, and a large proportion of these buds develop themselves if planted in boxes or pans of moist earth, and subjected to a genial bottom-heat. They may also be propagated by ringing the stems below the crown of sword-shaped leaves, and covering the cut part with a pot filled with moist earth, into which roots will be emitted, after which sever the stem entirely, and plant at once where it is to remain. A box of earth is often more convenient than a pot in operations of this kind. If the roots of many of the strong-growing hardy Yuccas are examined, they will be found to produce tubers or "knaws," and these often develop roots and shoots if removed and planted in pans or boxes on a genial bottom-heat. They are simply fleshy root-buds, and they succeed best if they are only partly buried in the soil. *Y. aloifolia* and its beautiful variegated forms may be propagated either by stem-cuttings (eyes) or cuttings of the thick fleshy portions of the root. I am not aware that any attempt has been made to fertilise or hybridise these plants in our gardens; and if this is attempted, it must be remembered that their flowers open at night. It appears possible that on their native plains these plants are fertilised by nocturnal lepidoptera or other insects, and this may account for their not often bearing perfect seeds in cultivation. Plants artificially fertilised would doubtless furnish plenty of seed; and now that their stately beauty is beginning to be admired, they will be much sought after, and increase in value.

Since the above was written, I find that Prof. Riley of St Louis, the state entomologist of N. America, has discovered that Yuccas are fertilised by a small white moth, which he calls *Pronuba yuccasella*, an insect which forms the type of a new genus. The female insect only has maxillary palpi, wonderfully modified into a long prehensile tentacle, with which she collects the pollen and thrusts it into the stigmatic tube; and after having thus fertilised the flowers, she consigns a few eggs to the young fruit, the seeds of which afford the food necessary for the existence of the newly-hatched larva. The Yucca is the only entomophilous (insect-loving) plant known which absolutely depends for fertilisation on a solitary species of insect,* and it is curious to note how admirably that insect is modified in its structure, as if especially for this purpose. It is curious also to observe that the pollen of Yuccas is glutinous, and is expelled from the apex of the anthers before the

* The same thing is suspected by Darwin to be the case with one of the most singular and the largest-flowered of all Orchids, *Angræcum sesquipedale* of Madagascar (see Darwin, "Fertilisation of Orchids").

flowers expand (see 'Garden,' iii. 499, for a highly-interesting illustrated account of the way in which Yuccas are fertilised by *Pronuba yuccasella*, Riley). More recent observations show that the Yucca moth does not insert her eggs into the stigmatic cavity, as was originally supposed, but that she lays them in the side of the young ovary by puncturing it with her ovipositor, after which she carries pollen and fertilises the stigma.

Yuccas do occasionally, although rarely, produce seed in this country, and apparently without insect agency, although it is next to impossible to be certain on the latter point. The late Dr Englemann of St Louis, writing in 1872 (see 'Gard. Chron.,' 1872, p. 941), says that it is impossible for the heavy, sticky pollen to reach the stigma without some extraneous aid; and adds that he has succeeded in fertilising the flowers just after they open in the evening.

Yucca quadricolor variegata has fruited in the gardens of La Muette. This plant is a variety of *Y. aloifolia*, of which it presents the general appearance and habit. The leaves, however, have a broad whitish-yellow band running through the centre. The fruit is also curiously marked, like the leaves, with a broad whitish-yellow band. M. Carrière considers that a large proportion of the seeds will reproduce the variegation.

The seeds of Yuccas germinate in a very curious manner. Instead of throwing up the plumule from the apex of the seed, and pushing the roots downwards, as in most Dicotyledons, Yucca seeds, in common with those of Palms, Clivias, and many other Monocotyledonous plants, throw out a long, curved, neck-like growth (*tigellum*), the swollen end of which contains the embryo; and after the neck has attained the length of about an inch, more or less, the embryo throws up a leaf and pushes down root-fibres nearly simultaneously. Cyclamen seeds germinate in much the same way, and this is the only instance of a Dicotyledon germinating in this curious manner that I can just now remember to have seen. With respect to seeds of this description, the question naturally arises, Why is the embryo thrown out of the seed before germination has taken place? Naturally, as we know, seeds are scattered on the surface of the soil; and this is undoubtedly one of Nature's ways of burying the embryo, and, until it forms roots and leaves, it is nourished by the feeding-bottle-shaped mass of cellular matter which remains on the surface of the soil. We have instances of plants which bury, or attempt to bury, their seeds, such as *Trifolium subterraneum*,

all the Cyclamens, *Arachis hypogæa*, and others; and in the case of Yuccas and Palms this power seems vested in the seeds themselves, or rather in that portion of the seed which represents the young plant. It seems probable to me that the seeds of Yuccas and Palms are especially fitted for germination in dry or barren soils; inasmuch as where soft seeds, which vegetate in the ordinary manner, would be dried up, these are protected from drought by a hard horny coat, and have the power of throwing out the embryo and of pressing it down into the soil, while at the same time it is amply fed by the albuminous pabulum stored up under the seed-coats until the roots can strike down deep enough to draw up food and moisture.

THE FLAX FAMILY (*Linaceæ*).

A small group of annual, perennial, herbaceous, or sub-shrubby plants, principally natives of Europe and North Africa. De Candolle remarks that this group is intermediate between Cloveworts, Mallows, and Cranesbills. One species, *L. usitatissimum*, is much cultivated for its tough fibre and diuretic seeds, which forms the basis of the "oilcake" used for cattle-feeding purposes, after the oil (linseed) has been expressed.

Linum (*Flax*).—A genus of annual or sub-shrubby plants, represented in our gardens by *L. grandiflorum*, *L. trigynum*, and others; while the common Flax, from the fibre of which our linen is prepared, has been cultivated for ages. It is one of the first plants mentioned in the Bible, and has been discovered in a manufactured state in the most ancient of Egyptian tombs. Flax (*Linum usitatissimum*) is now only known in a cultivated state, or has become so altered as to be unrecognisable. Mr Baker thus writes on this subject in his 'Botanical Geography,' p. 87: "One of the most noteworthy points about the common plants of cultivation is that many of the commonest and best-known so-called specific types, as the Sugar-cane, Wheat, Oat, Tomato, Artichoke, Tobacco, *Gossypium herbaceum*, and *G. barbadense*, are totally unknown anywhere in a wild state. But of all these, what are called distinct species of the same genus are known; and it can scarcely be doubted, judging from the amount of variation which we see in types of which the origin is known, such as the Cabbage, Apple, Pear, and Cherry" (Carrot, Parsnip, &c.), "that the original types of these others are not really lost, as was commonly supposed till lately, but that an amount of change, equivalent to that of an

ordinary species, has been wrought by domestication. Heer has lately traced the common cultivated Linseed (*Linum usitatissimum*) of the present day down into *Linum angustifolium* at the date of the Swiss lake-dwellings." The annual and herbaceous species are easily propagated from seeds, and cuttings of the shrubby section root freely in heat.

The Lobelia Family (*Lobeliaceæ*).

A group of acrid or poisonous plants, principally natives of the West Indies, Brazil, North India, the Cape of Good Hope, and New Holland—some representatives being also found in Chili and the Sandwich Islands. Most of the species are characterised by the syngenesious anthers which, in nearly every case, discharge their pollen before the stigmatic surface of the style is exposed, or capable of being impregnated. As in Composites, the hairy tip of the style forces its way through the tube formed by the adherent anthers; only in Lobeliads the tips of the anthers form a closed bilabiate mouth, fringed with hairs, and from this mouth the dry bluish pollen is forcibly expelled, if these marginal hairs are irritated, either by the pencil of the observer, or by insects in their struggles to enter the hairy orifice of the curved flower-tube. The pollen of Lobeliads, if inhaled, produces symptoms of nausea analogous to "hay fever."

Lobelias are readily propagated, either by seeds sown in pans of light, rich, sandy earth, and placed in a pit or frame near the light, or by cuttings. Sown as soon as ripe in a gentle bottom-heat of 60° to 70°, they germinate readily.

L. erinus and most of its varieties seed freely, but if any particular form is desired, the individual must be increased by cuttings.

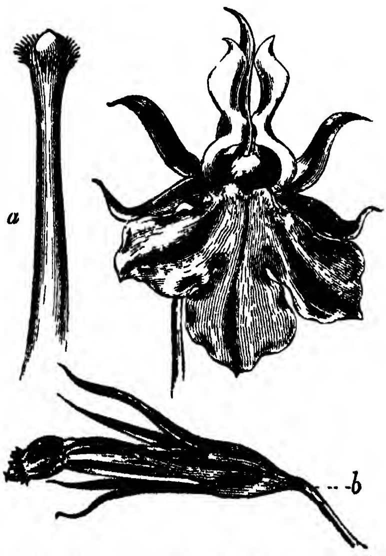
We learn from the 'Florist' that the following mode of propagating *Lobelia fulgens* has been successfully practised at Mr Ware's, Hale Farm Nurseries, Tottenham: "The pots containing the Lobelias are plunged in cocoa-nut fibre; then the flowering-stems are nearly cut through about an inch from the base, and laid down on their sides, partially covered by the fibre, using pegs or stones at intervals, to keep them in position and close to the plunging material. The result is that plants are formed at every joint of a shoot, for the joints root readily; and thus an abundant supply of plants can be obtained. This plan, moreover, aids the working of the old method of taking off the young growth that comes round the base of the stem, as

the severance of the main spike directs the vigour of the plant mainly to the production of side growth."

Centropogon and *Siphocampylus* are readily multiplied by cuttings of the young growth in heat, or by seeds, which are readily obtainable by artificial fertilisation.

Rhynchopetalum montanum is a rare and distinct plant, with a stem something like a Cycad or "Grass-tree" (*Xanthorrhœa*). It is difficult to propagate, but offsets are produced from the scaly stem, if it is kept moist by a thin layer of damp sphagnum moss.

Lobelia.—A showy genus of herbaceous plants, principally natives of America, and represented in our gardens by *L. cardinalis* (see 'Bot. Mag.,' t. 320), *L. fulgens*, and *L. longiflora* (see 'Bot. Mag.,' t. 2563). *L. gigantea* is a strong-growing species, with large yellow flowers (see 'Bot. Mag.,' t. 1325), and *L. tupa* (*ibid.*, t. 2550), bears a large panicle of crimson flowers. There are numerous other species of this large-growing section, but some of the fine old kinds are lost. The modern varieties of Lobelias have originated from *L. cardinalis* and *L. fulgens*, and are very variable in colour, the various shades of rose, scarlet, crimson, purple, and blue being most prominent. Of the



Lobelia erinus, var. *speciosa*—*Flower enlarged. a, Style, b, Ovary, calyx, stamens, and style.*

small-growing or *L. erinus* section, we have also numerous seminal and cross-bred forms, the prevailing colours of which are blue and white. The dwarf-growing varieties of the *L. pumila* section closely resemble the old *L. minuta* (see 'Bot. Mag.,' t. 2590), which has a low tufted habit, and bears small blue flowers. *L. minima* (*ibid.*, t. 2077) is another pretty little plant, similar in habit to the last, but bearing small flowers of a rosy pink and white colour. The old *L. erinus* is a weak straggling plant, often nearly two feet in height, and quite distinct from the now popular races of seedlings which have been selected from it, since the rage for low free-flowering bedding-plants commenced. *L. coronopifolia* is a distinct low-growing plant, bearing large deep blue flowers on one or two flowered scapes. It was introduced from the Cape about 1787 (see 'Bot. Mag.,' t. 644). A still finer species, *L. cærulea* (*ibid.*, t. 2701), somewhat similar in habit to the last, bears three or four flowered panicles of large Pinguicula-like light-blue flowers.

Cultivated Lobeliads are represented by species of *Lobelia*, *Centropogon*, *Syphocampylus*, and *Rhynchopetalum*. The old *Lobelia surinamensis* (see 'Bot. Mag.,' t. 225) very closely resembles the new hybrid *Centropogon* (*hybridus*) *Lucyanus*.

Kœlreuter was one of the first who attempted hybridising the species in this genus, and he obtained a very interesting series of hybrids between the "Cardinal Flower," *L. cardinalis*, and *L. syphilitica*, as early as 1771.

Lobelia Fabrii is a garden-hybrid, raised in French gardens It is supposed to be the result of a cross effected between *L. cardinalis* (Cardinal Flower) and *L. syphilitica* (see 'Revue Hort.,' 1866, p. 269).

Lobelia Lowii ('Bot. Reg.,' 17, 1455) is said (Herbert's 'Am.,' p. 346, 352) to have been an accidental hybrid between *L. syphilitica* and *L. fulgens*, and the former is supposed to be the female parent, as it seeds more freely than *L. fulgens*. Kœlreuter ('Act. Acad. Pet.,' 1780) raised hybrids between *L. syphilitica* and *L. cardinalis* reciprocally, and found them fertile when crossed back with either parent, but sterile with their own pollen. *L. Lowii*, cited above, is, however, said by Herbert to have produced seed with him, when planted in a border together with its parents; but the offspring, with one or two exceptions, did not approximate to either, but resembled the hybrid, with some variability in colour.

Centropogon (*hybridus*) *Lucyanus* (see 'Revue Hort.,' 1868, p. 291) is a very attractive winter-flowering plant, raised by M. Desponds of Marseilles in 1856. The female parent was *Centropogon fastuosus*, fertilised with pollen of *Syphocampylus*

Syphocampylus Humboldtianus. *a*, Stigma with its two divisions firmly closed; *b*, Stigma with its two divisions open or expanded—that is, in a receptive state; *c*, Syngenesious anther-case, showing how the pollen is ejected on the apex being irritated; *d*, Old and partly withered flower, showing receptive stigma after it has emerged from the syngenesious anther-case; *e*, Anther-case and style, twice natural size, *f*, Pollen-grains magnified.

betulæfolius, and it was named in honour of M. Lucy, President of the Horticultural Society of Marseilles. The flowers are of a bright rosy colour, borne in axillary fascicles.

Syphocampylus Humboldtianus (*S. fulgens*), see 'Bot. Mag.,' t. 5631. Anther-cases syngenesious, blue-black in colour, striate, and of a peculiarly hard texture, almost horny. When irritated at their hairy, tea-kettle-like mouth, the yellow flour-like pollen is ejected with considerable force, to a distance of one to three inches. When confined inside the syngenesious tube formed by the anthers, the two lip-like lobes of the stigma are firmly closed and adpressed, as at *a*, the object of this arrangement being to prevent self-impregnation. The stiff ring or ellipse of hairs (which is analogous to those on the outer surface of the stigmas of Composites) is doubtless intended for brushing the pollen from the anthers, as the growth of the style gradually pushes it up the tube formed by the anthers. Thus, while the stigma is confined inside the tube, it is not fully developed or receptive, and its use is to push out the pollen for the benefit of other flowers. When it does effect its escape, a curious change, here also analogous to that in Composites, takes place. The two lips of the stigma open, as at *b*, and become viscid, and are then readily fertilised by pollen from younger flowers.

The Misseltoe Family (*Loranthaceæ*).

Loranthus.—A genus of dichotomous plants, usually parasitic, and having opposite or alternate bright green entire leaves, and hermaphrodite or unisexual flowers, often freely produced, and of various colours, these being succeeded by a succulent one-seeded fruit, which, like the flowers and coloured stems, is also very ornamental. They are for the most part natives of tropical Asia and America, a few being found in Africa, and the species are still more rare in Europe. One or two European species have been established in the Botanic Gardens at Glasnevin.

The late Dr Welwitsch * often alludes to the beauty of the tropical Loranths, especially those native of S.W. tropical Africa, and he collected about thirty species when travelling in Angola, where they are parasitic on evergreen, and more rarely on deciduous, trees and shrubs. Some of the species are very beautiful, having red, pink, or yellow, erect or pendulous stems, often clothed with bright green leaves and delicately-tinted flowers. They evince a predilection for the Adansonia trees,

* See a paper in 'Jour. Royal Hort. Soc.,' 1873 (New Series), iii. 120.

but many species also occur on [illegible] [illegible], on introduced Orange and Lemon trees, and copiously on the common cultivated Fig (*[illegible]*). Some of these species, if introduced, might give additional interest to our plant-houses and conservatories. I believe Mr W. Bull did introduce one or two species a year or two ago, but these lovely and variable plants do not seem to have obtained the attention they deserve. "The greater number of the Angolan *Loranthi* glitter with flowers of a more or less pink or scarlet hue, but about half-a-dozen of the species are adorned with golden or orange-coloured blossoms, and all the species are exceedingly free-flowering. They flower in Angola in the spring—*i.e.*, from September till November; but many of the finest species continue their blooming during almost the whole summer, when they may be found not unfrequently covered with ripe fruits at the base, while they are still in full bloom at the top of one and the same branch of their foster-tree."

Viscum.—A curious genus of parasitic plants, represented by the common Misseltoe (*V. album*) in our orchards and woods. The flowers are unisexual and diœcious,—that is, borne on separate plants, the female plant being more luxuriant in its growth than the male; and there are many varieties, doubtless of seminal origin, which vary in habit and size of the leaf and fruit. It is commonly found growing on the Apple, Lime, Poplar, Hawthorn, Maple, and more rarely on the Oak and Chestnut. It can best be propagated by seeds, which should be gathered when ripe in April or May, and pressed on to the bark on the under side of the branches of the trees on which it is desirable that it should grow. Some make slits in the bark, but the berries will grow quite as readily if allowed to adhere to the bark by their natural viscidity. If placed on the upper side of the branches, they are liable to be pecked off by birds. Many fail to propagate this plant through attempting to do so at Christmas, when the berries are abundantly used for indoor decorations, but the seeds are then in an unripe state, and this accounts for their non-germination. The seed throws out roots, and takes hold of the bark in two or three weeks after being rubbed on the tree. It is necessary to protect the seeds from birds. Grafting succeeds in spring just as the sap of the Apple or Lime begins to move. Cut a sprig of Misseltoe, wedge-shaped at the base, and make an oblique slit in the bark of the stock to receive it, after which cover the wound with cold grafting-wax. For an account of this curious parasite, see 'Trans. Linn. Soc.,' xxiv. 175, or 'Jour. of Bot.,' 1864, p. 361. In the 'Garden,' iv. 12, is an in-

teresting account of this tree-pest; and the following list of about twenty trees on which it has been found growing may be useful to those who wish to propagate the plant as a curiosity or for decorative purposes. It is singular to find that this evergreen plant nearly always selects deciduous trees on which to develop itself:—

Apple.	Robinia.	Medlar.
Aspen.	Ash.	Birch.
Sycamore.	Lime.	Black Poplar.
Oak.	Elm.	Maple.
Whitebeam.	Silver Fir.	Hazel.
Briar.	Whitethorn.	Mountain Ash.
Pear.	Willow.	Hickory.

The Misseltoe furnishes us with one of the few known instances of duplicate or self-parasitism. Mr Corderoy, of Didcot, has recently sent to the 'Gardeners' Chronicle' some specimens of Misseltoe parasitic on itself. The young seedlings have attached themselves to the parent branches just in the same way that they usually do to branches of the Lime or any other tree. Mr Corderoy mentions also a variegated form, produced as a sport, and alludes to other variations in habit.

THE LOOSESTRIFE FAMILY (*Lythraceæ*).

A small group of attractive decorative plants found in Europe, N. America, and the tropics of both hemispheres, and represented in our gardens by the genera *Lythrum*, *Cuphea*, *Lagerstrœmia*, and one or two others. Lythrums generally seed freely, and Cupheas are easily multiplied either by cuttings of the young growth or seeds. Lagerstrœmias are Indian shrubs, which are in the gardens of India what the Lilac is here at home. *L. indica* is a well-known plant, bearing dense masses of rosy-lilac flowers, with long-stalked crisped petals. Cuttings of the young wood root freely in heat; and seeds germinate readily, sown as soon as ripe, on a gentle bottom-heat of 70° to 80°.

Lagerstrœmia elegans carnea is described in the 'Garden' as a new variety, raised from seed of *L. elegans* by M. F. Sahut of Montpellier. It has the habit and vigorous growth of its parent, resembling it also in the structure of the flowers, which, as is well known, differs from that of the flowers of *L. indica*; but the flowers of *L. e. carnea*, instead of being of a brilliant deep rose colour, like those of *L. elegans*, are of a delicate rose or flesh colour, becoming almost white when they begin to fade.

In the coloration of the flowers, this variety differs essentially from the three other varieties of Lagerstrœmia at present in cultivation, and forms a [illegible] type, not less free-flowering and not less remarkable than the others in a genus which up to the present has exhibited few variations. In this respect it is a valuable acquisition, for few plants flower more splendidly than the Lagerstrœmias.

The Hollyhock and Cotton Family (*Malvaceæ*).

A well-defined group of herbaceous plants, annuals, shrubs, or trees, mostly natives of the tropics and sub-tropical regions. In Europe they are represented by Mallows (*Malva*), and from one species of *Althæa*, *A. rosea*, all the lovely forms of our garden Hollyhock have originated. The most important plants, from an economic point of sight, are the different species and varieties of *Gossypium*, from the seed-pods of which the cotton of commerce is obtained. The following are the principal genera in this group: *Althæa*, *Lavatera*, *Malva*, *Malvastrum*, *Sida*, *Abutilon*, *Malvaviscus*, *Abelmoschus*, *Hibiscus*, and *Gossypium*. As a rule, seeds are freely produced by nearly all the plants in the order, and these germinate readily if sown as soon as ripe—the hardy species in a cold frame, and the tender or tropical kinds in heat. On the other hand, some species, as *Hibiscus rosa-sinensis*, very rarely produce seeds even in India. Mr W. Williamson of Belair, Dulwich, has however received seeds of this plant, ripened in Devonshire, from which young plants were obtained.

Abutilon.—A well-known genus of greenhouse plants, with cordate or palmate foliage and drooping bell-shaped flowers,—*A. venosum*, *A. striatum*, *A. braziliense*, *A. Darwinii*, and others, being well-known examples. All the species are readily multiplied by seeds and cuttings, or by grafting the choice variegated kinds on *A. striatum* as a stock. Several beautiful hybrid or seminal forms have been raised in Continental gardens, one of the best of these being the pure white *A.* "Boule de Neige," which flowers very freely in the open air in summer and in a warm conservatory in winter. This plant somewhat resembles the old *Sida globiflora* (see 'Bot. Mag.,' t. 2821), which was introduced to our gardens from the Mauritius as long ago as 1827. By hybridising this plant with *A. Darwinii*, a new and very attractive race might possibly be produced. Hybrid Abutilons have frequently been raised in Continental gardens, but I can find no record

of any having been raised in this country. In 1848, hybrids were obtained, two of the most interesting being *A. venoso-striatum* and *A. striato-venosum*, which are the result of reciprocal crosses between *A. striatum* and *A. venosum*. In 1855, M. Lambotte of Namur exhibited several interesting hybrid Abutilons, which were the produce of *A. striatum* fertilised with pollen from *Sida albida*, and to these mules an extra prize was awarded by the Ghent Horticultural Society. It has often been observed that when the golden-blotched Abutilons are grafted on the green-leaved *A. striatum* as a stock, the latter is frequently induced to produce golden-blotched foliage below the junction of the scion with the stock. A case is mentioned (see 'Gard. Chron,' 1875, p. 750) in which M. Jean Driessche of Ghent succeeded in grafting the new *Abutilon Darwinii* on to the variegated *A. Thompsonii* as a stock, the result being that subsequent leaves produced by the graft also became variegated as in the form *A. tesselatum*.

Althæa.—A genus of hardy malvaceous, annual, biennial, and perennial plants, represented by the Marsh-mallow in marshes near the sea, and by the stately Hollyhock in our gardens. The last named plant is one of the very few hardy flowers which are noble enough in habit to produce landscape effects. Mr Chater of Saffron-Walden, a well-known grower and exhibitor, who has done much to improve and popularise this noble-habited flower, recommends their being propagated by single eyes in July and August, also by cuttings in the spring, placed on a slight bottom-heat. Plants raised in summer are best preserved by re-potting them in October into large pots —the larger the better—in light, rich, sandy earth, and placing them in a cold frame or greenhouse, giving plenty of air on all favourable occasions: they will then grow during the winter. In March or April turn them out into the open ground, and they will bloom as fine and as early as if planted in the autumn. Plants even put out in May will flower the same year.

New varieties are, of course, only to be raised from seed; and the usual practice adopted by raisers is to grow a select collection of smooth, round-petalled, semi-double varieties close together, from which seeds are saved, which, like Stocks and Asters, produce a certain proportion of perfectly double flowers; and the better the strain or selection, the larger is the proportion of perfectly double seedlings obtained. The parent from which the present race of Hollyhocks has been produced is *A. rosea*, a herbaceous biennial introduced from China in 1573. The common single-flowered seedlings may be used as stocks on which to graft the tender double kinds. Cleft-grafting or

crown-grafting on the neck or collar of the root in April and May are the best plans to [illegible]. M. [illegible] recommends that the scions or grafts be [illegible] beforehand, and buried in dry sand, as they are liable to rot. They should be sheltered from frost. Graft close to the ground, or better still, take up the roots, cut off the stems of the stock at the collar, and insert the grafts on the junction between the stem and root. This plan prevents, to a great extent, suckers rising from the stock.

In the 'Gardeners' Chronicle,' 1845, p. 475, a curious instance is related of a double-yellow Hollyhock which suddenly produced single white flowers, and then a cluster of yellow flowers, very double, again made its appearance among the other lateral spikes. M. d'Auch, who originally communicated the information to the 'Revue Horticole,' remarks that this case is all the more singular, since varieties of *Althæa rosea* once obtained are very permanent, and produce themselves again by their seed. This last fact is corroborated by Dean Herbert in his 'Amaryllidaceæ,' p. 366, where he says: "It is to be observed that in some cases the seminal varieties of plants preserve themselves almost as distinct in their generations as if they were separate species: for instance, the cultivated double Hollyhocks, of which at least the orange, the yellow, the white, the black, the red, and the pink may be raised with certainty by seed from plants of the several colours, although planted near together in the garden; yet it is probable that if gardeners were to take the trouble of crossing them with pollen from plants of a different colour, a greater multiplicity of hues would be procured."

Gossypium (*Cotton-plants*).—The plants of this group, or at least the species which yield the cotton of commerce, are found in Asia and America. In India, Egypt, and other Asiatic countries, Cotton has been cultivated from time immemorial, just as Flax (*Linum*) has been also grown for ages. From the 'Treasury of Botany,' p. 544, we learn that "the use of Cotton dates from prehistoric ages, both in the Old World and the New. It is frequently mentioned in the 'Institutes of Menu,' a work written eight centuries before the Christian era." The aboriginal Americans used it for clothing long before North America was discovered by Europeans, and manufactured articles of Cotton have been found in the tombs of the Peruvian Incas. *G. barbadense* is the species cultivated in the American States; and cultivation and selection have supplied varieties, each of particular excellence, in different localities, or as supplying finer-stapled fibre than the type. *G. herbaceum* is the native Indian or Asiatic species, its

forms being largely grown in British India. *G. peruvianum*, or Kidney Cotton, is the type cultivated in South America. All the species are perennial shrubs or herbaceous plants, but in cultivation they are treated as annuals and raised from seed, which germinates readily in a genial bottom-heat of 70° to 80°. The varieties of Cotton interbreed readily, and numerous kinds were raised prior to 1871 by Col. Trevor Clarke, and these plants were exhibited in a greenhouse especially erected for them near the Exhibition of 1871. Col. Trevor Clarke has very kindly given me the following remarks on cross-bred varieties of Cotton: "In Gossypium, cross-bred plants were produced for purposes of improvement many years ago by Mr Burns and others in India, and afterwards largely by myself. In a series of experiments, extending over many years, I found that the Eastern Cottons, *G. herbaceum*, with its innumerable forms, and the nearly-related purple-blossomed *G. arboreum*, would interbreed freely amongst each other. The occidental or New World Cottons were also found to cross with each other, and to produce fertile offspring; but no union could be effected by artificial impregnation between the Asiatic and American plants. Note here, that the rough or hairy-leaved type of American Cotton, represented by the New Orleans, has been frequently cultivated experimentally in India, and in one district successfully; various other members, too, of the occidental type have also been brought thither for the same purpose. These would all cross or interbreed with each other. It is, however, an unfortunate circumstance that the American New Orleans plant has become confused by planters with the true Asiatic race, under the common name of *G. herbaceum*, and that thus has sprung up the erroneous notion that the two races were capable of hybridisation. The results of artificial breeding amongst the Cottons may be summed up briefly as follows: The Asiatic sorts were not improved in any very marked degree. Some of the best of the multitudinous local varieties were crossed with each other with the usual and well-known result in such cases—to wit, strengthened constitution, and greater development of parts; but at present the most improved examples will not bear comparison with the ordinary American kinds. The cross between *arboreum* and *herbaceum* was verified, and the produce had some marked good qualities. The occidental or American family was also experimented upon largely; the numberless related forms were crossed and recrossed with each other over a period of nearly twenty years, and the produce sent out to be tested in the various Cotton-growing countries. The physical results were in the highest

degree successful, and the importance of using highly-developed cultivated sorts to improve the inferior forms used by native cultivators was fully confirmed.' An elaborate trial of these is now being made by Mr Empson of Williston (South Carolina), with every prospect of success." It is very interesting to know that Cotton-plants may be grafted readily when in a very young state; and in the 'Gardeners' Chronicle,' 1871, p. 1260, is a figure of a grafted seedling, the scion being united to the stock just below its (the scion's) seed-leaves.

Hibiscus.—A group of shrubby garden plants, of which *H. syriacus* (*Althæa frutex*), *H. sinensis*, and the numerous seminal forms of each type, may be cited as examples. They are readily propagated by seeds, which are produced only as a rule after careful artificial fertilisation, and these should be sown at once in light rich sandy compost, and placed in a gentle bottom-heat of 65° to 70°. Cuttings of the young wood root freely; or the rare and choice varieties may be splice or cleft grafted on the common kinds. It would be interesting to know whether the beautiful single and double forms of *H. sinensis* would succeed grafted on pieces of the root, or on seedlings of the hardy *H. syriacus.*

Hibiscus syriacus is a showy rosy-flowered shrub from Syria, and of this there are numerous white, red, crimson-striped, and double varieties in our gardens. It is increased by layers, and occasionally by seeds, which are sparingly produced. Miller remarks that the scarce varieties may be propagated by grafting them on each other, or on common sorts, which is the usual method of propagating the kinds with striped leaves (see 'Bot. Mag.,' t. 83).

M. Gaudais of Nice raised a hybrid some years ago between *Hibiscus moscheutos*—which has persistent foliage and a dry fruit—and *Achania malvaviscus*—which has deciduous foliage and a berry-like fruit. The last-named was the seed-parent, and the hybrid is said to have resembled it in bearing deciduous leaves and habit; while the flower was double.

THE MAGNOLIA FAMILY (*Magnoliaceæ*).

A very ornamental family of evergreen and deciduous trees or shrubs, bearing conspicuous, and in many cases fragrant flowers, their foliage being also generally noble in form and large in size. The species are natives of North America, China, Japan, and Northern India, and belong to *Liriodendron* or *Magnolia*.

Liriodendron (*Tulip-tree*).—Only one species is known in this genus, this being a native of North America, and common in our gardens. *L. tulipifera* forms a tree forty or fifty feet high, and is easily recognised by its curious saddle-shaped foliage. Its cup-shaped red and yellow or greenish flowers are produced in the summer months. Imported seed grows freely sown in the spring, either in a cold frame or in sheltered nursery beds. *L. tulipifera*, var. *obtusifolia*, bears larger flowers than the type, and may be propagated by grafting, as in *Magnolia*. The Tulip-tree rarely ripens its seeds in this country; but if seeds cannot be obtained, hillock-layering may be resorted to, as in *Magnolia*.

Magnolia.—A well-known genus of highly ornate deciduous or evergreen flowering trees and shrubs, many of them, as *M.*

Entire flower of Magnolia grandiflora.

Magnolia grandiflora.
L. Mass of pistils or carpels of pistils.

grandiflora and its varieties, *M. glauca*, *M. purpurea*, and others, being quite hardy in this country, and admirably adapted for sunny walls. All the species are readily increased by imported seeds, which ripen well in Italian, Spanish, and even French gardens, but rarely in this country, except on very warm soils, artificial fertilisation being advisable in order to induce the fruit to set well. *M. conspicua* ripened its seeds in 1871 at Carclew, Cornwall. Seeds should be sown in shallow boxes of light rich earth in the spring, and placed on a genial bottom-heat of 60° to 70°: they germinate well, although rather irregularly. Hillock-layering is employed, and with *M. grandiflora* and other strong-growing kinds it is successful; and the plants so obtained do not grow so grossly, and bloom earlier

than seedlings. Cuttings of the young wood root freely in heat, and may be resorted to when seeds or layering cannot be adopted. Layers, seeds, or grafting are the methods, however, most generally made use of in good tree-nurseries. The weak-growing or other deciduous kinds do best on seedlings of *M. discolor* or *M. glauca;* the method generally adopted being to side-graft pieces of the young growth, when tolerably hard, on to the neck of the stock, without heading it down. July and August are the best months for this operation, the stocks being grown in pots and worked in a close frame. The union between the parts generally takes place in five or six weeks. Some use layers as stocks, but fresh young seedlings are to be preferred. The evergreen kinds do best on *M. grandiflora* as a stock. Some of the deciduous kinds, as *M. Soulangeana*, *M. discolor*, *M. purpurea*, *M. Lennei*, and others, are so beautiful, even in a small state when grown in pots, that they deserve culture for conservatory decoration in the spring; and, with a little care in hybridising, a race of dwarf, bushy, free-flowering forms might be obtained. I have seen plants of *M. Lennei* in a thirty-two-sized pot bear eight or ten of its deliciously fragrant flowers, which are satiny-white within and deep purple outside, being so elegantly bell-shaped or vasiform withal, that one can only wonder why it is so rarely seen cultivated in pots. The fruits of Magnolias are long and fleshy, the seeds being exposed when fully ripe; and in this country pot-culture in a greenhouse and careful fecundation would be the most certain means of obtaining them. Numerous seedlings of *M. grandiflora* have been raised in this country—*M. grandiflora*, var. *exoniensis*, being the best. *M. Campbellii* is a magnificent rosy-flowered species, figured in Hooker's 'Himalayan Plants,' and is quite hardy in Ireland—a tree having stood out several years near Cork. It is certainly one of the finest of all the species, and ought to be invaluable to the hybridiser. Herbert, in his oft-quoted 'Amaryllidaceæ,' observes: "The French have favoured us with some desirable Magnolias from *M. Yulan*, fertilised by *M. obovata* and *M. gracilis;* but the mixture of the Chinese species with the magnificent *M. grandiflora*, and with the very hardy *M. tripetala*, is probably still in expectation." M. Porcher, in his interesting work, 'Du Fuchsia,' tells us that *M. Soulangeana* was obtained in 1826, and that it is a seedling from *M. Yulan*, fertilised with pollen from *M. obovata discolor*, and that it was named by the Société d'Horticulture de Paris in compliment to the raiser, M. Soulang-Bodin, and it may possibly be one of the French hybrids alluded to by Herbert, but which he does not name.

M. Lennei is a garden hybrid, and is one of the finest of the deciduous group. It is of Italian origin, and is supposed to be the result of a cross between *M. Yulan* and *M. purpurea* (see 'Flore des Serres,' t. 1693-94). *M. Thomsoniana* is a garden hybrid between *M. glauca* and *M. tripetala*, and *M. conspicua Nobertiana* is supposed to be the result of fertilising *M. conspicua* with pollen of *M. purpurea*. *Magnolia macrophylla* is a noble, large-leaved plant, which bears salver-shaped white flowers, which, being open and loose, remind one of an enormous Mallow. The flowers are fully twelve inches in diameter (see 'Bot. Mag.,' t. 2189).

THE CANNA FAMILY (*Marantaceæ*).

A small natural family of tropical herbaceous or evergreen plants, represented in our gardens by many beautiful-leaved species and forms of *Maranta* and *Calathea*. *Thalia dealbata*, and the numerous species and still more numerous improved hybrid or seminal forms of *Canna* or "Indian Shot," also belong to this group. *Marantas* and *Calatheas* are easily multiplied by dividing the rhizomes of established plants. Seed is rarely produced except by careful cross-fertilisation, and the floral envelopes should be removed as early after the flower decays as possible, or they induce the seed-vessels to decay. *Thalia* and *Canna* are also easily multiplied by dividing the tuberous rhizomes, and the last named produces fertile seeds in abundance on warm rich soils. Seeds should be sown in the spring in a genial bottom-heat of 70° to 80°, and may be planted out on a warm border in June. Nearly all the beautiful-foliaged and flowering varieties of *Canna*, now so popular in our garden arrangements, have originated in Continental gardens. Parkinson figures a variety of *Canna* in his 'Paradisus' (1629), and describes a form with yellow flowers spotted with red, so that this plant is an old one in our gardens. There is every reason to believe that the *Canna* will some day ere long rival the *Gladiolus* in the beauty and variety of its flowers. Numerous seminal varieties, cross-bred forms, and hybrids have been raised in French and Belgian gardens; but hitherto the object has been to obtain fine-foliaged varieties rather than to develop their inflorescence.

C. iridiflora (see 'Revue Horticole,' 1875, p. 291) bears splendid spikes of crimson-scarlet flowers, and a very fine form raised by M. Jean Sisley, named C. Jean Vandael (see 'Revue Hort.,' 1869, p. 171), deserves the attention of hybridists. The

last-named plant was obtained by crossing the varieties C. Maréchal Vaillant, and C. Député Hénon, its flowers being two to three inches in diameter and deep crimson-scarlet in colour. Other large-flowered varieties have been raised by M. Année, M. Sisley, M. Chaté, and others; and some of the best of these which seed freely might with advantage be crossed again with *C. iridiflora*, so as to obtain a race of large-flowered kinds having fixity of character. The following is a select list of the best-flowering kinds, which may be used either as pollen or seed bearing parents by the cultivator. The first class includes dwarf kinds only—say not above two feet in height; the second class grows three or four feet; and the third class from four to seven feet, or even taller. It will be seen that these plants are of far nobler habit than the Gladiolus, and are also of easier culture, and we hope to see many handsome seedlings raised in English gardens as well as on the Continent, and we may reasonably expect that some of these will rival the tropical *Marantas* in foliage, and at the same time delight us with their handsome flowers.

First class—Prince Imperial, bright scarlet; *Bihorellii*, orange-scarlet; *Bihorellii elegans*, Indian yellow; *Bihorellii splendens*, bright scarlet; Michel Bonnett, bright crimson; Gustave Bonnett, orange-scarlet; *Mullerii*, crimson; *grandiflora floribunda*, orange; *compacta*, yellow, spotted red; *Ferrandii*, bright crimson. Second class—Senateur Chereau, yellow, with red spots; *lutescens*, yellow; *Imperator*, dark scarlet, orange-spotted; *gigantea floribunda*, orange-buff; *rotundifolia rubra*, orange; *picturata fastuosa*, light yellow, spotted red. Third class—Premice de Nice, canary-yellow; Auguste Ferrier, scarlet and orange; *Rendatlerii*, orange-buff; Député Hénon, yellow and rosy-red, shaded; Ernest Benary, orange-red; Van Houttei, bright orange-red.

THE MEADOW-SAFFRON FAMILY (*Melanthaceæ*).

Very few plants in cultivation belong to this order, the principal being different species of *Veratrum*, *Tricyrtis*, *Bulbocodium*, and *Colchicum* or autumnal Meadow-saffron. The flowers are very variable in form and size, being either unisexual or hermaphrodite. Nearly all the cultivated species are hardy; but the order, although a small one, is widely distributed over the earth's surface. They are very poisonous. The herbaceous section, like the Japanese *Tricyrtis* and the European or American *Veratrums*, are readily multiplied by

carefully dividing large established clumps, while seed germinates freely if procurable. The bulbous species of *Bulbocodium* and *Colchicum* are readily propagated by seeds sown on pans of sandy earth as soon as ripe or in the following spring, and placed in a warm frame to vegetate. Offsets or division of large clumps affords another way of multiplying these beautiful plants.

The Bertolonia Family (*Melastomaceæ*).

A large order of tropical plants, many of which are grown in our gardens for decorative purposes. De Candolle remarks of this group as follows: "Although composed entirely of exotic plants, and established at a period when but few species were known, it is so well characterised that no one has ever thought of putting any part of it in any other group, or even introducing into it genera that do not rightly belong to it." The distinctive characters of *Melastomads* are the opposite and generally three-nerved leaves, the veins running from the base to the apex, and the curious long-beaked anthers. The principal genera cultivated are *Centradenia*, *Lasiandra*, *Pleroma*, *Melastoma*, *Monochæton*, *Rhexia*, *Medinilla*, *Bertolonia*, *Sonerila*, *Sphærogyne*, *Phyllagathis*, *Cyanophyllum*, *Platycentrium*, and others. Nearly all the species are readily multiplied from cuttings of the young or partially-hardened growth, while leaf-cuttings are successful, especially in the case of *Phyllagathis*, *Sonerila*, *Bertolonia*, and some species of *Medinilla*. Layers and circumvallation are successful methods—in particular cases the last-named process being handy, in order to secure the tops of old specimens of *Cyanophyllum* and *Sphærogyne*. But little has been done by hybridisers in this group, notwithstanding which the few results obtained have been remarkably beautiful, notably the hybrid *Bertolonias* of M. Van Houtte and the *Sonerilas* of Messrs E. G. Henderson & Son. These triumphs ought to stimulate others, especially when we consider what handsome species might serve as a groundwork of the hybridist's experiments. Fancy the lovely purple flowers of *Lasiandra macrantha* borne on a good-habited plant like *Pleroma elegans!* Then, again, the *Monochætons* would doubtless give a beautiful race of hybrid decorative plants. Seeds are rarely borne by these plants unless the flowers are artificially fertilised; but when obtainable, they germinate very readily sown on a pan of light leaf-mould and sand placed in a genial bottom-heat of 70° to 80°. A pane of glass or a piece of brown paper should be placed over the pan to prevent undue evaporation. The sexual organs

of nearly all *Melastomads*, and especially their anthers, seem specially formed for securing cross-fertilisation by insect-agency, and every group of plants which depends more or less on insects for fertilisation seems to be especially liable to produce hybrids. The curious structure of the long curved-pointed anthers, and the curved stamens and long connective, seem to act in a manner analogous to that of *Salvias*; while the pollen is by some species ejected on the stamens being irritated, just as in *Lobeliads*. For figures of the sexual organs of these curious plants, see 'Trans. Linn. Soc.,' vol. xxviii., part 1.

Several hybrid or seedling forms of Bertolonia have been raised. To M. Van Houtte, of Ghent, we are indebted for *B. Van Houttei* (one of the handsomest), *B. Mirandæi*, and *B. Marchandii.* The first-named variety was exhibited in England in 1875.

The Fig-Marigold Family (*Mesembryaceæ*).

A natural group of succulent, sub-shrubby, or herbaceous plants, having opposite simple leaves, and showy purple, rosy, yellow, or white flowers, similar to those of Composites or Portulaceas in general appearance. They are principally natives of the Cape of Good Hope, a few being found in South Europe, North Africa, China, and Peru. In our gardens they are represented by two or three hundred species and varieties of *Mesembryanthemum*, and by *Lewisia rediviva*, an American plant bearing showy rose-coloured flowers. All the species of Fig-Marigold are readily multiplied by cuttings inserted in dry sandy compost in the summer months; and, like other succulents, the cutting pots or pans should be placed on a sunny shelf near the glass of a warm greenhouse or vinery. Nearly all the species seed freely; but the seed-vessels, being fleshy, are liable to damp. Seed-bearing plants should have the flower-buds thinned, and the petals should be cut away from the seed-vessel as soon as they fade, or they cling around it and cause damp and mould. A dry and sunny shelf in a warm greenhouse or pit is the best position for seed-bearing plants. Seed should be sown either as soon as ripe or in the spring—say March or April—on the surface of a well-drained seed-pan filled with sandy compost. Water very carefully with a fine rose after sowing, and cover the whole with a flat pane of glass, and set the pan on a gentle bottom-heat of 65° to 70°, until the young plants appear, after which remove the pane, or tilt it so as to admit air freely, and set the seedlings on a sunny shelf near the glass until fit for potting off.

THE FIG AND MULBERRY FAMILY (*Moraceæ*).

An order of useful fruit-bearing or ornamental plants, natives of temperate and tropical latitudes in both hemispheres, but especially abundant in the tropics, where numerous climbing Figs abound in the forests. The principal genera are: *Morus* (Mulberry), *Broussonetia* (Paper Mulberry), *Maclura* (Osage Orange), *Ficus* (Figs), and *Dorstenia*. The plants in this group are monœcious, and remarkable for the flat or fleshy receptacle in which the seeds are immersed. In the case of the common Fig, cross-fertilisation—generally so easy in monœcious plants—is next to impossible, the male and female flowers being crowded together inside the fleshy fruit. The Mulberry is readily propagated by cuttings of the old wood; large branches, three or four feet long, root freely if driven into the earth like stakes. M. Baltet recommends grafting or budding on the seedling white Mulberry as a stock, flute-grafting in April or shield-budding in August being most successful. Budding is most successful in warm soils, and may be performed as early as midsummer. Budding with a pushing eye in April is also recommended by the same author, the scion branches having previously been preserved by burying them in sand behind a north wall.

Mulberry-trees were introduced into England, early in his reign, by James I., who spent £935 in planting them near his palace; and by royal edict, about the year 1605, offered packets of Mulberry-seeds to all who would sow them, for the purpose of encouraging the cultivation of silk-worms for the promotion of silk-manufacture in this country. The royal patronage rendered the tree so popular that there is scarcely an old garden or gentleman's seat which existed in the seventeenth century, in which a Mulberry-tree is not to be found. In 1609, Sieur de la Foret, who had in France a nursery of 500,000 plants, travelled over the midland and eastern counties of England for the sale of Mulberry-trees, and distributed not less than 100,000.

The Osage Orange (*Maclura*) strikes from cuttings as freely as the Willow; and M. Neuman observes that new terminal buds are developed from the cambium layer more freely than lateral ones from latent buds on the old stems. Nearly all the Figs root freely from cuttings of the young or hardened wood; and the common Fig, like the Grape Vine, is easily propagated by burying branches for two or three months, after which they are found to root freely when placed in a genial bottom-heat.

Layers are also successful. The Banyan-tree is one of the noblest examples of natural layering in the vegetable kingdom. Many of the ornamental kinds root freely from herbaceous or woody cuttings in a close heated case, or they may be multiplied by grafting cuttings on thick bits of the roots of common kinds, after which pot carefully into small pots, and plunge them in a close heated case.

Fruiting branch of the Fig (Ficus Carica) a, Fig cut longitudinally to show the collection of flowers inside, b, One of the staminate flowers, c, One of the pistillate flowers; d, Ripe fig cut open to show the collection of fruits; e, One of the fruits, f, Seed with embryo

Ficus religiosa, F. indica, F. elastica, F. Chauvieri, and others, may be propagated by inserting eyes or short pieces of the stem, each having a single leaf and the bud at its base attached. Dorstenias are readily propagated by herbaceous cuttings or by division. Seedlings of the edible Fig vary very much in size, flavour, form, and colour; and the numerous forms—upwards of a hundred—now grown in this country have been raised in French, Spanish, or Italian gardens. Doubtless some are merely cultural varieties, and, as we have

before observed, any systematic course of intercrossing is next to impossible, unless, indeed, the fruit can be partially severed —*i.e.*, slit open when the open orifice indicates the perfection of the flowers—and the foreign pollen introduced, after which the fruit might be held together by an elastic band until the margins united again; or it might be possible to insert the point of a fine brush or feather, moistened with honey or nectar, and charged with pollen. The variety of fruits obtained when seeds of imported Figs are sown seems to point to hybridisation having previously been effected at some time or other, unless, indeed, we can ascribe this seminal variation to a long course of cultivation.

The Banana Family (*Musaceæ*).

A small genus of large-leaved plants, principally natives of the Cape of Good Hope, Madagascar, and pretty generally throughout the tropics, where Musas are largely grown for their edible fruits under the names of Plantains and Bananas. A dwarf-growing Banana from China is often grown in our hot-houses as a choice fruiting-plant under the name of *Musa Cavendishii.* The principal genera are: *Musa*, *Strelitzia*, *Heliconia*, and *Ravenala* or *Urania*, the "Travellers' tree" of Madagascar. *Strelitzias* and the edible *Musas* are readily propagated by separating the offsets or suckers, which are freely produced. *Musa ensete* does not throw up suckers, but is readily raised from imported seeds, which, like those of *Ravenala*, germinate freely in a genial bottom-heat. *Heliconias* may be propagated by division, or if seeds can be procured, they germinate readily in a close heated frame. *Musa Cavendishii* and *M. sapientum* are the most useful as fruit-bearing plants in this country; and it is interesting to notice that in the tropics, where they have been long cultivated, there are numerous varieties differing in the size, colour, and flavour of their fruits. The varieties having short plump fruits, with delicate rose-tinted pulp, are the best, and are as much sought after as are the finer Pears or Grapes here in our gardens at home. The pendulous flower-spike of Musa, with its unisexual female flowers above the male blossoms, seems a simple provision to favour cross-fertilisation with other varieties occasionally; and it would be worth while to try the effect of pollen of *M. sapientum* on *M. Cavendishii*, and *vice versâ*, whenever and wherever this is practicable. It is singular to observe that the edible-fruited Musas, like the Pine-apple, rarely bear fertile seeds—a state of

things favoured by the system of propagating them by suckers or offsets in cultivation.

Strelitzia.—A small genus of gorgeous orange and purple or white-flowered Musads from the Cape, and represented in our gardens by *S. reginæ*, *S. juncea* (*S. parvifolia*), and *S. humilis.* The flowers remind one of those of Irids, and consist of six segments, the three outer (sepals) usually of a brilliant orange colour (white in *S. augusta*), while the three inner ones are unequal, the two lower ones united, forming an arrowhead-like hood, of a rich purple colour, and concealing in a slit or fold the five perfect stamens and an imperfect one. The three-celled capsule contains numerous seeds, each having an orange-coloured tuft of hairs. These fine flowering and foliage plants are much hardier than is generally supposed, and well deserve more general culture. Numerous beautiful seminal varieties, which, if not actually true hybrids, are of equal practical importance, have been raised in Belgian gardens (see 'Ann. de la Soc. d'Agriculture et Bot. de Gand,' t. i. p. 419). The Belgian varieties are: *S. aurora*, *S. imperialis*, *S. rutilans*, *S. citrina*, *S. vitrea*, and others; and these have been raised from seeds of the well-known *S. reginæ* fertilised with pollen of *S. angustifolia*, *S. juncea*, and *S. humilis.* The pollen of these plants is well worth examination, being spherical, and having a hard thick outer membrane, finely punctate or pitted, and scarcely separable from the internal coat.

The Myrtle Family (*Myrtaceæ*).

A group of trees and shrubs, mostly evergreen, and represented in our gardens by different species of *Eucalyptus*, *Callistemon*, *Metrosideros*, *Leptospermum*, *Babingtonia*, *Punica* (Pomegranate), *Psidium* (Guava), *Pimenta* (Allspice), *Myrtus* (Myrtle), *Caryophyllus* (Clove), *Eugenia*, *Jambosa* (Rose-apples), and several other genera. Nearly all the plants in this group are natives of hot countries, and abundant in the tropics. New Holland and the South Sea Islands contain genera peculiar to their shores, while the most northern species is the Common Myrtle (*Myrtus communis*), which, although originally a native of Persia, is now abundantly naturalised in Europe. Aromatic properties characterise the order; while some genera, as *Psidium*, *Jambosa*, and *Eugenia*, produce edible fruits, even in cultivation. Most of the species are evergreen. Seeds germinate freely in a bottom-heat of 70° to 85°, and cuttings of the young growth root freely in a warm plant-case or frame. It does not

appear to be generally known that Myrtle-branches, five or six inches long, root freely in water, even in a dry window, although a close case would be better if at hand. Many other plants root freely in tepid water, but extra attention is required in transferring the cuttings to the soil in potting. Hybridism is of rare occurrence in this group; but there are many seminal varieties of *Psidium* (Guavas) and *Eugenia*. Myrtles are readily multiplied by grafting in heat, and the double-blossomed Myrtle grows and blooms much better when worked on the common single-flowered type (*M. communis*) as a stock.

The Pitcher-Plant Family (*Nepenthaceæ*).

Nepenthes (*True Pitcher-plants*).—A very curious and interesting group of plants, natives of the tropics, many fine species being found in Borneo and the other islands of the Malayan archipelago. Some of the finest species, as *N. Edwardsiana*, *N. Lowii*, *N. Rajah*, and others, are as yet unknown in this country, except by dried specimens. The male and female flowers are borne on separate spikes; and careful artificial fecundation is necessary to insure the production of good seed. Several beautiful hybrids have originated in the Chelsea nursery of Messrs Veitch & Son, a descriptive list of these being given below. Seed should be sown, as soon as it is ripe, on the surface of a pan or pot filled with spongy peat and surfaced with living sphagnum moss; and in a high moist temperature these germinate readily. Imported seeds treated in the same way seldom fail to grow; but if sown in soil in the usual manner, they never succeed. Cuttings of the lateral shoots or breaks, which are produced near the base of the main shoots, strike root readily if placed in a close heated case on a layer of living sphagnum moss. If the cuttings are set upright between strips of lath, so much the better. Some insert the base of the cuttings in shell or Derbyshire spar, instead of moss, with equal success; while in the Belgian nurseries we have noted an ingenious plan of rooting Nepenthes by setting small inverted flower-pots on a bed of sphagnum moss, and placing the base of the cutting through the drainage-hole. This plan may also be used for cuttings of Dracænas and many other kinds of plants which root better in moist air than in damp earth.

Dr Moore, of Dublin, has succeeded in grafting *N. Hookerii* on *N. ampullacea* as a stock; but little is to be gained by this

mode of propagation. Still it is interesting to know that this method is practicable.*

Some of the species naturally exhibit a tendency to vary: thus *N. Hookerii* is a form of *N. Rafflesiana*, having shorter, rounder, and more highly-coloured pitchers; and the red and green pitchered varieties of *N. rubra* (Hort.) are natural sports or seminal forms of *N. khasyana*, a plant often met with in gardens under the name of *N. distillatoria*. The pitchers of these plants are so variable even on the same individual plant, that no reliance can be placed on them as marks of specific distinction.

The following hybrid forms, raised by Messrs Veitch, are in cultivation, our descriptions being abbreviated from the 'Florist:'—

N. Chelsonii.—Stem downy; leaves, including the petiole, 16-18 inches long, 3-4 inches broad, glabrous; pitcher 3-4 inches long, 2½ inches broad, purple-spotted. This form is a cross between *N. Rafflesiana* (*Hookerii*), which was the male parent, and *N. Dominii*, the female parent, the latter being itself a hybrid. The pitchers are somewhat like those of *N. Rafflesiana*, but broader, and with the mouth less prolonged at the back.

N. Sedenii.—Stem glabrous; leaves 7 inches long, 1¾ inch wide, coriaceous, glabrous; pitcher (probably not fully developed) 3 inches long, 1 inch wide, oblong. This form is stated to have been raised from the pollen of *N. khasyana* (*distillatoria*) applied to the female flower of an undetermined species.

N. Dominii.—Stem purplish, slightly downy; leaves glabrous, elliptic-lanceolate, tapering at the base, and decurrent along the sides of the petiole; pitcher 6 inches long, 2 inches wide, oblong, deeply winged, wings purple, spotted and fringed at the margin; mouth infolded at the edge, furrowed, prolonged at the back into a long tapering striated process about an inch in length; lid oblong, 2 inches long by 1¼ inch wide, smaller than the mouth of the pitcher, speckled with purple glandular dots, ribbed at the back, and provided at the base with an excurrent recurved process. This form is stated to have been the result of the fertilisation of the female flowers of *N. Rafflesiana* with the pollen of an undetermined species from Borneo.

N. hybrida.—Stem glabrous; leaves oblong-acute, tapering at the base into a short stalk, glabrous; pitchers 5 inches long, membranous, green, or with a few purple spots within. This form, and the succeeding one, are stated to have originated

* For an illustrated account of the origin and development of the Pitchers of Nepenthes, and descriptions of new species, see 'Trans. Linn. Soc.,' xxii. 415.

from seeds taken from the same capsule. The male parent is stated to have been *N. khasyana*, the female an unknown species from Borneo.

N. hybrida maculata.—Stem glabrous; leaves glabrous, coriaceous, oblong-lanceolate; pitchers 5 inches long by 1½ wide, cylindric, oblong, purple-spotted. This form resembles *N. Boschiana* in the pitcher, but is winged.

N. intermedia.—This is evidently a robust and free-growing variety, and is the result of a cross between *N. Rafflesiana* and an unnamed species with small spotted pitchers. The pitchers are about the size of those of *N. hybrida maculata*, but resemble those of *N. Rafflesiana* in shape and colour. This interesting hybrid was obtained by Mr Court, one of Messrs Veitch's foremen, and was first exhibited in 1875.

Wherever *N. Rafflesiana* has been used in raising the above hybrids, no matter whether as male or female, its prepotence over the other species used with it is very evident in the offspring.

THE MARVEL OF PERU FAMILY (*Nyctaginaceæ*).

This is a small group containing but few garden plants of especial interest. *Mirabilis jalapa* (see 'Bot. Mag.,' t. 371), the common Marvel of Peru, is still a favourite flower in some gardens, on account of its evening and night-blooming habit, and fragrance. Although often grown from seeds and treated as an annual, it is a perennial, and its roots may be taken up and preserved in sand just like Dahlias. In the work above cited the different coloured varieties are said to come true from seed. The species are all natives of Peru and Mexico. They are very readily propagated by seeds and by careful division of the tuberous roots. Cuttings root readily in heat, and form tubers and flower the same year. The type of *M. jalapa* bears rosy flowers, and of this, two of the earliest variations were two sports, the one bearing yellow and the other white flowers. The flowers opening in the evening gives this plant an especial value, as it forms an attractive companion to the night-scented Stock, Mignonette, and other fragrant flowers. Between 1846 and 1862,* M. Lecoq obtained numerous self-coloured, bicolor, and tricolor, or striped forms of *M. jalapa*; and in 1847 he obtained plants intermediate between *M. jalapa* and *M. longi-*

* For a full and interesting account of M. Lecoq's hybrid and cross-bred *Mirabilis*, see 'De la Fécondation et de l'Hybridation,' p. 300; see also Naudin on Hybridism, 'Jour. Royal Hort. Soc.' (New Series), i. 5.

flora, the last being a deliciously-perfumed species, having long-tubed flowers. It is singular to observe that when *M. longiflora* was made the female parent, all attempts at hybridisation proved abortive, while an inversion of this cross gave numerous hybrids, and these, when crossed, gave a numerous progeny in the second generation. M. Lecoq has also hybridised *M. jalapa* with *M. dichotoma*, the result being plants bearing yellow flowers, or flowers striped with yellow and white.

THE WATER-LILY FAMILY (*Nymphæaceæ*).

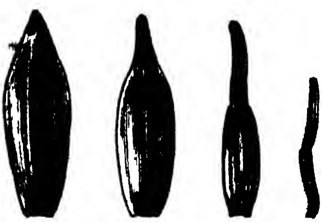
A group of very beautiful aquatic or floating plants, inhabiting the whole of the northern hemisphere, occasionally met with in Southern Africa, while in South America the highest beauty in the whole group is met with in *Victoria regia*. In Nymphæas we find a gradual transition from sepals and petals to anthers and stamens, and this group is one of the very few in which semi-double flowers are the normal state. All the plants in the order are readily propagated from seeds, which should be sown in a pot of loamy soil and sand, and plunged beneath the surface of a warm tank, fully exposed to the sun. The rhizomes may be divided in the case of the hardy kinds. Imported seeds should be sown as soon as received. The *Victoria* is generally and most conveniently treated as an annual plant in our gardens, but it is a

Nymphæa alba, L. *a*, Flowering plant entire, showing flowers, expanded leaves, and others in involute vernation; *b*, Fruit with scars on the outside; *c*, Transverse section of the fruit; *d*, Seed cut longitudinally; *e*, Seed showing embryo; *f*, Seed natural size and magnified

perennial like the other species. It does not appear to be generally known that manure has a wonderful effect on the common white *Nymphæa alba*, causing it to grow with tropical vigour, and produce leaves and flowers fully twice the ordinary size, and so distinct in appearance that one would readily imagine plants so stimulated to be a distinct variety. A hardy crimson-flowered variety is said to grow in Sweden, and with this we might produce some charming effects by grouping it with the ordinary snowy-flowered species. *N. pygmæa* is a Liliputian plant, with flowers little larger than half-a-crown and leaves in proportion, and this is well adapted for aquarium culture; and if fertilised with pollen from *N. rosea*, *N. cærulea*, or other species, a race of elegant miniature Nymphæas might be the welcome result (see 'Bot. Mag.,' t. 1525).

Entire flower of Nymphæa alba, L. (White Water-Lily).

It is said to be really a native of E. Siberia, but has long been a favourite with Chinese gardeners. In 1851, M. Ortgies obtained fertile seeds from *N. rubra* (flowers of which he had carefully emasculated) fertilised by pollen from *N. Ortgiesiana*, and the seeds produced plants which flowered the year following, and are described in 'Flore des Serres,' t. viii. p. 69, as being intermediate between the parents in colour (rose), but tending towards the female in habit, time, and duration of flowering. The hybrids also possessed increased vigour, and produced flowers more pro-



Nymphæa alba, L., series of forms through which the petals (E F G), *each of which bears an anther, pass to the state of the normal stamen* (H).

fusely than either parent; and so late as December one plant bore seven flowers in one day! This hybrid, *N. Ortgiesiano-rubra*, is sterile—*i.e.*, will not produce fertile seeds if fecundated with its own pollen, notwithstanding that the organs are all healthy and pollen abundant. It is singular to find, however, that this pollen which fails to fecundate its attendant stigmas, will fertilise flowers of other species. M. Planchon attributes this to the absence of the necessary heat in the flower of *N. Ortgiesiano-rubra* at the time the stigma is receptive, and it would be interesting to know whether the same reason can be assigned for similar effects in the case of some Passifloras. A rise of temperature has been noted to take place in Nymphæa flowers during the time the stigmas are receptive, which is generally at night or in the early morning. In 1853, M. Bouché, of the Berlin Botanic Garden, obtained a very pretty hybrid *Nymphæa*, with pale rosy flowers, by fertilising the stigmas of *N. rubra* with pollen from *N. lotus;* and a second batch was raised by M. Bouché in 1857, seven of which were the result of fertilising emasculated flowers of *N. rubra* with pollen of *N. lotus*, and others were seedlings from the first hybrids fecundated with pollen of *N. lotus*. M. Donkelaar fertilised the *Victoria* and different species of *Nymphæa* reciprocally, but obtained no striking results, although fertile seeds were obtained (see 'Belg. Hort.,' t. viii. p. 280). Some years ago Mr Gower, when at Kew, made some interesting experiments which proved very conclusively that cross-fertilisation of the *Victoria regia* — *i.e.*, fertilisation with pollen from other flowers on a distinct individual plant—conduces to increase fertility (see p. 101).

N. Devoniensis (see 'Bot. Mag.,' t. 4665), or *N. hybrida*, as it is sometimes called, is a hybrid raised at Chatsworth from *N. rubra*, fertilised with pollen of *N. dentata*, or its near ally, *N. lotus*. It is one of the finest of all the crimson-flowered Nymphæas. Seeing that Nymphæas hybridise freely, and afford such splendid results, we hope some cultivator will be bold enough to attempt hybridising our chaste *N. alba* with pollen from some of the more brilliant tropical species or varieties. Why should we not have crimson, rose, and cerulean Water-lilies as well as gorgeous Rhododendrons? It may be impossible, but hybridists should never give that word a place in their vocabulary until they have tried and failed.

The Olive Family (*Oleaceæ*).

Trees or shrubs with hermaphrodite or unisexual flowers, and for the most part natives of northern latitudes. The following genera are represented in our gardens: *Chionanthus*, *Olea*, *Phillyrea*, *Ligustrum* (Privet), *Myospyrum*, *Fraxinus* (Ash), *Fontanesia*, *Syringa* (Lilac), *Forsythia*, and a few others less well known. One or two species are of economic importance, notably *Olea europæa*, the fruit of which affords Olive or Salad oil, and *O. fragrans*, the flowers of which are used by the Chinese in flavouring tea. Most of the species are readily multiplied by seeds, which in the case of Olives, Ash, Privet, and Lilac, are freely produced in favourable localities. Cuttings may also be employed, and layering in autumn is successful. Grafting is generally resorted to in propagating the Flowering Ash (*Fraxinus ornus*) and the Manna Ash (*F. rotundifolia*), both of which succeed on the Common Ash as a stock. M. Baltet recommends shield-budding in July or English cleft-grafting in March and April, and observes: "Reject the buds at the base of the branches,—they do not develop readily. After budding the tops of the scion, shoots may be utilised by side-grafting them under the bark. When the graft or bud begins to sprout, the stock should be closely disbudded; but a few leafy shoots should be retained here and there, to draw and keep up the flow of the sap." All the seminal and hybrid Lilacs may be grafted on seedlings of the common kinds.

De Candolle, in writing on Olive-worts (see 'Essai Méd.,' p. 204, and Lindl. 'Veg. King.,' p. 616), remarks: "However heterogeneous the Olive-worts may appear as at present limited, it is remarkable that the species will all graft upon each other —a fact which demonstrates the analogy of their juices and their fibres. Thus the Lilac will graft upon the Ash, the *Chionanthus*, and the *Fontanesia;* and I have even succeeded in making the Persian Lilac live ten years on *Phillyrea latifolia.* The Olive will take on the *Phillyrea*, and even on the Ash; but we cannot graft the Jasmine on any plant of the Olive tribe —a circumstance which confirms the propriety of separating these two orders."

Syringa (*Lilacs*).—A group of spring-blooming shrubs found in most gardens, the Common Lilac (*S. vulgaris*) and the Persian Lilac (*S. persica*) being the best-known species or types. *S. vulgaris* and some of its lilac-purple varieties are much used for forcing by the French florists; and being subjected to a humid heat and total darkness, the flowers as-

sume a pure white colour. Bush-lilacs in pots are extremely useful for greenhouse or conservatory decoration in the spring, and these are obtained by working the best of the new seminal varieties on seedlings of the common species in heat. Two centuries ago the Lilac was worked on suckers and seedlings of the Common Privet as a stock; but plants grafted on either Privet or Ash are short-lived. Spring is the best time for grafting, and the operation should be performed in a close case. If seedling stocks are not handy, suckers are generally obtainable from the shrubberies; and these, if potted and placed in a gentle heat, soon root afresh, and form excellent stocks. Among the older varieties we must name *S. rothomagensis* (the Siberian or Rouen Lilac). As to the history of this shrub there are differences of opinion. It was first introduced to our gardens in 1795. Some writers assert that it is a native of Siberia, and a distinct species; others that it is a hybrid raised about the latter end of the last century by M. Varin, the then director of the Botanic Gardens at Rouen, the parents being *persica* and *vulgaris*. The probabilities seem to be in favour of the latter theory, as in general appearance it is just what might be expected from the blending of the styles of growth, foliation, and flowers of the two species. Numerous improved seedling and cross-bred forms have of late years made their appearance in French and Belgian gardens, one of the best being the richly-coloured form known as "Charles XII."

Among the new varieties, Ville de Troye, a dark-flowered and late-blooming variety, promises well; and Rouge ponctué, of very bright colour, is equally good. Géant des Batailles and De Croncels are both of them brilliant varieties. The blossoms of Gloire des Moulins are flesh-coloured, and said to be very fragrant; while Aline Mocqueris, of dwarf growth and a very abundant flowerer, may prove extremely valuable for planting nearer to the front of shrubberies than the taller-growing kinds. Notwithstanding all this wealth of novelty, one still finds the old kinds—the common broad-leaved (*Syringa vulgaris*) and the Persian or narrow-leaved kind (*S. persica*)—being alone used (with very rare exceptions) in the planting of new shrubberies, even the magnificent and well-known variety distinguished as *S. Lindleyana* being, as yet, found in very few gardens.

Mdlle. Legrave, florist, of Liège, has succeeded in raising a new variety of White Lilac, which is described in the 'Belgique Horticole' as being exceedingly fine, the flowers being of large size, good substance, and of the purest white colour, with

anthers of a golden yellow, and arranged in large well-furnished clusters. The jury at the International Exhibition at Maestricht awarded the plant a first prize, and also bestowed on it the title of Reine des Pays-Bas (Queen of the Netherlands).

S. Souvenir de Billiard is a vigorous seminal variety raised by M. Ch. Billiard, Fontenay-aux-Roses, and was sent out in October 1875.

The Fuchsia and Evening Primrose Family (*Onagraceæ*).

A small group of shrubs or herbaceous plants widely scattered in both hemispheres, but principally natives of temperate countries. They are represented in our gardens by the following genera: *Isnardia*, *Sphærostigma*, *Œnothera*, *Godetia*, *Clarkia*, *Epilobium*, *Zauchneria*, *Fuchsia*, *Lopezia*, *Gaura*, and others. There is a tendency in this order to lose the petals, or rather not to develop them, several species of *Fuchsia* being apetalous, and Lindley observes that *Clarkia pulchella* sometimes exhibits the same peculiarity. The shrubby species are for the most part readily multiplied by cuttings of the young or partially-hardened wood. Herbaceous kinds are easily propagated by division, and seeds of all the species germinate readily, and are in many cases borne profusely, especially by the annual sorts. The hybridist has improved some of the Clarkias; and the genus *Fuchsia* has been so much improved, that it is rare to meet with pure species in cultivation. Gaertner remarks that he failed to hybridise those Œnotheras with rough and angular seeds with those having smooth and round seeds; and we have several other instances where the two or more sections of a genus will not interbreed: thus Primroses having a valvular orifice, as *P. acaulis*, will not breed with *P. auricula*, which has an open throat; Ericas with cylindrical blossoms with those having bell-shaped corollas; nor blue Linums with the yellow-flowered species, to say nothing of the aversions shown by Pelargoniums, Begonias, and Lilies.

Fuchsia.*—A genus of free-growing plants, all South American, if we except *F. excorticata*, *F. Kirkei*, and *F. procumbens*, which are natives of New Zealand. It is nearly a century since *F. coccinea* was introduced to this country; but florists' varieties

* Cultivators and hybridists interested in Fuchsias should see the Histoire et Culture du Fuchsia, suivies d'une nomenclature méthodique des plus belles variétés connues, par M. Félix Parcher. Paris, 1874. Auguste Goin, Rue des Ecoles, 62 (ancien 82), près le Musée de Cluny.

appear to have been first produced about 1837, or soon after the introduction of the long vermilion-flowered *F. fulgens*. Then came *F. corymbiflora*, *F. cordifolia*, *F. serratifolia*, and others; and the cross-breeding which took place between the long-flowered kinds and the globose varieties produced many beautiful forms, including those named in the following list, which was contributed to the 'Gardeners' Chronicle' by Mr W. B. Hemsley:—

Varieties of Fuchsia sent out from 1837 to 1844.

Raised by John Salter, then living at Versailles—*Albino*, *Audoti*, *Baudouin*, *Brennus*, *Edwardsii*, *Géant*, *Gloriot*, *La Chinoise*, *Mirabelle*, *Oreste*, *Princesse de Joinville*, *Paragon*, *Salterii*, *Sanguinea superba*, *Thibauti*, Victoria, Vulcan.

Cattleugh—*conspicua arborea.*

Chandler—*Chandlerii.*

Cripps—*Venus victrix*, a beautiful and elegant variety, which has given issue to several more vigorous ones, such as *Sydonie* (P. Smith & Co.), Lady Franklin (Smith, 1853), *Thalia* (Turner, 1855), *Venus de Medicis* (Banks, 1856), which it was attempted again to send out as new in 1873

Dickson—*Dicksonii*, *floribunda.*

Epps—Bridegroom, *Eppsii*, Hero of Kent, and Marion

Harrison—Amanda, Admirable, Clio, Desdemona, Enchantress, Fairy, Fama, Formosa, Florence, *globosa longiflora*, Goldfinch, Madonna, Meteor, Prima Donna, Queen, Rosabella, Vesta, *venusta*, and Zenobie.

Ivery—*Iveryana.*

Lane—*Lanei.*

Low—*bicolor.*

Lucombe—*exoniensis* (1842), a hybrid between *cordifolia* and *globosa.*

May—*floribunda magna*, *pendula*, *terminalis*, *pulchella*, *stylosa maxima*

Miller—Constellation, between *fulgens* and *corymbiflora.*

Pontey—*tricolor*, remarkable for its beautiful colouring.

Smith—Queen Victoria (1842).

Standish—Aurora, *delicata*, Hebe, *Standishii* (*F. fulgens* × *F. globosa*) (1840), Attraction, Colossus, and President (obtained in 1843).

Todd—*Toddiana.*

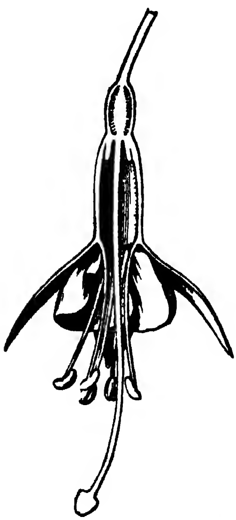
Thomson—Formosa, *elegans* (1841).

Youell—*Youellii* (1843?)

According to M. Porcher, the true hybrids in this genus are but few—*F. exoniensis* (*F. cordifolio-globosa*) (see 'Paxt. Mag. of Bot.,' x. 151), *F. Standishii* (*F. globoso-fulgens*). *F. Toddiana* is another hybrid from the same parents ('Bot. Reg.,' t. ii., 1840). *F. Dominiana* is from *F. spectabilis* fertilised with pollen of *F. serratifolia*, and was sent out in 1854. Hybrids between *F. globosa* and *F. magellanica* have been obtained, together with numerous half-breds, and hundreds of beautiful cross-bred varieties. Hybrid Fuchsias, like hybrid Calceolarias, are as fertile as the true species.

The first white-sepalled Fuchsia was Venus victrix. This

plant was raised by Mr Gulliver, gardener to the Rev. S. Marriott of Horsemonden, Kent. It was sent out in May 1842 at 21s. each by Messrs Cripps, of Tunbridge Wells, who at the time described it as follows in their advertisements: "The flowers of this unique variety are white, sepals delicately tipped with green, with a superb bright purple corolla, the stamens of a delicate rose, and the pistils white. The plant is of excellent habit, with foliage about the size of *F. gracilis*, of which it is believed to be an accidental variety." This plant was the forerunner of a whole race of beautiful white-sepalled flowers. Mr Dominy informs me that he knew an instance where this variety, Venus victrix, was used as a seed-bearing plant crossed with pollen from *F. serratifolia*, and all the seedlings were like the male parent in every particular—a very interesting fact, as proving in this case the prepotence of the male parent. Venus victrix has recently been reintroduced to commerce by Mr H. Cannell of Woolwich, and is one of the best of all the white-sepalled varieties for hybridising purposes. One of the first of the varieties having a white corolla and red sepals was F. "Madame Cornellison," which originated on the Continent in 1860.



Longitudinal section of the flower of Fuchsia splendens

Interesting and in many cases descriptive lists of hybrid and seedling Fuchsias may be found in the advertisement columns of the 'Gardeners' Chronicle' for 1841 and subsequent years, the principal raisers then being Youell, Epps, &c.

Fuchsias are all very readily and quickly propagated by cuttings of the young growth in a gentle bottom-heat—indeed even old leaves and cuttings of the roots develop into plants readily. If a heated case is not handy, slips or cuttings root well pricked into the soil of any pot in the window. To use a popular expression, cuttings of the Fuchsia "root like couch-grass," and this is the quickest and readiest way of increasing well-known varieties. New varieties are easily raised from seed; and as nearly all the cross-bred forms seed freely, any desirable variety may be selected as the seed-parent, its flowers

being emasculated as soon as the buds open, and fertilised with pollen from another good variety which has bright colour or other qualities to infuse into the seed of the female parent. The fertilisation of Fuchsias is easy to effect, as the stigma is prominent, and the anthers of nearly all the species and varieties furnish a copious supply of fertile pollen-grains. Many varieties, indeed, produce a copious supply of seed without any artificial fertilisation; and if a house or frame full of good varieties is grown, the bees or other insects, or the wind, do the work of the hybridist, and often very successfully. It frequently happens, however, that Fuchsia-seed is hollow or otherwise defective; but the good seed is readily known, after it is separated from the pulp and dried, by its being firm or plump, and of larger size than the sterile or barren seeds. When the fruit are ripe, cut them open and lay the produce of each cross on a clean towel or linen cloth, between the folds of which rub the seeds until dry. A fine cloth is best, as the seeds are small. Sow at once in pots or pans of leaf-mould and sand, placing them on a gentle bottom-heat until germination takes place, when they should be placed on a sunny shelf in a warm pit or greenhouse until large enough to be separately potted. If well-grown seeds are sown in the autumn as soon as ripe, they bloom the following summer. Some prefer, however, to sow in the spring, which is best, unless a heated house is at command. Good Fuchsia-seed saved from fine varieties is worth £50 per ounce. Fuchsias are so easy to grow, so easy to fertilise artificially, and the result is known so quickly, that they are well adapted for trial by the amateur; and if distinct and good varieties are carefully crossed, the result is sure to give some good flowers. There is yet plenty of new ground to be broken up in this genus; many of the Chilian species have not been hybridised; and the newly-introduced *F procumbens*, with its upright or erect flowers and slender drooping habit, fruits freely, and will probably give a new race in the hands of the hybridiser. We have erect-flowered Gloxinias, and let us hope to see more erect-flowered varieties of Fuchsias, with large flowers, since much of the beauty of the Fuchsia is lost at present unless its drooping flowers are seen from below, just as used to be the case with the pendent-flowered *Gloxinia speciosa*. We have already one erect-flowered variety—viz., *F. erecta superba* (see 'Revue Hort.,' 1868, p. 407). During the past ten or twelve years, great improvements have been effected by Mr Banks, Mr Cannell, and other well-known raisers. We have very fine forms with white corollas, others trumpet-

shaped, and numerous double varieties, yet there is room for a gracefully-habited race of the *F. gracilis* type; and the pretty little *F. microphylla* is distinct, and might be improved. Besides *F. coccinea*,* there are several other species and old varieties now at Kew, among them *F. alpestris*, *globosa*, *gracilis*, *microphylla*, *fulgens*, *corymbiflora*, *radicans*, *splendens*, *thymifolia*, and others, all valuable to the hybridiser for crossing with some of his newer forms, so as to infuse fresh life and vigour into them, and perchance obtain some novelty in form or colour at the same time. The distinct race of which *F. fulgens* is the type deserve careful attention on the part of the hybridiser, since they are easily grown, and having tuberous roots and herbaceous stems, can be stored away in sand or dryish soil just as readily as Gloxinias.

Mr H. Cannell, of Woolwich, thus writes on the raising of new florists' or decorative Fuchsias in the 'Gardeners' Magazine,' 1875, p. 251: "Many of those who have not made Fuchsias a special study think that the improvement of these flowers has been pushed to its utmost limits. But I need hardly say that this is a mistake. Years ago—I am unable to say how many—we were told precisely the same thing, and yet immense strides have been made during the last few years. Depend upon it, there is plenty to be done in this direction, especially with the varieties bearing flowers with a white tube and sepals. Surely we must not be satisfied with these, although some of them are very fine. We want varieties of a more free and graceful habit, and bearing flowers of larger size and better shape. I see no reason why we should not have these with flowers quite equal in every way to those of the dark sorts. There is also a possibility of obtaining a quite new type of flower. If we inquire into the history of the Fuchsia, we shall find that some remarkably distinct forms have made their appearance in the seed-beds of the raisers, and, in my opinion, at a time when they were least expected. There is, for example, Venus victrix, which Mr Cripps gave us thirty-three years ago. This is the first variety with a white tube and sepals raised and introduced into cultivation, and for some time it was thought to have quite disappeared, but after great difficulty I succeeded in procuring a plant. This being the first break from the dark varieties, there is more purple in the corolla than in the corollas of the other varieties, and by crossing it with the newest sorts some really fine things may be reasonably

* For an interesting account of the true *F. coccinea* of Aiton, see 'Jour. Linn. Soc.,' x. 458.

expected. About twenty-two years ago, Mr Storey gave us the first of those with white corollas, which included Queen Victoria, Mrs Storey, and Lady of the Lake, all of which have now been surpassed; and about sixteen years ago Mr Banks gave us a decided new colour in Venus de Medici. I should like to see something more done with the hardy sorts, such as *Riccartonii*, *coccinea*, and *gracilis*. Mr Bland has been successful in raising several really good hardy hybrids, and, for the sake of those who admire Fuchsias and have no place in which to grow the tender sorts, I would like to hear of more making their appearance. There are also the winter-flowering species, which of themselves are capable of affording plenty of work during the next ten or fifteen years, for those who are prepared to take them in hand with a determination to do them justice. There is, for example, *serratifolia*, and the well-known hybrid *Dominiana*, both of which are capable of immense improvement; and, in addition, there is the robust-growing *fulgens*, which has flowers of immense size and of a very bright colour."

Since the above was written, Mr E. J. Lowe has crossed some of the best modern varieties with *F. fulgens*, and some very distinct seedlings are the result (see 'Gard. Chron.,' 1875, p. 655).

There are two beautiful old species apparently lost to our gardens. I allude to *F. Lycioides*, a dwarf, profuse-blooming, crimson-purple species (see 'Bot. Mag.,' t. 1024), and *F. arborescens*, which bears large erect panicles of rosy flowers (see 'Bot. Mag.,' t. 2620).

It should be generally known that Fuchsias may be grafted as readily as Camellias, or even more so, since stocks are to be raised in a week or ten days. Grow the stocks in heat, and take the apex of a young shoot of any desirable variety as a scion. Splice or whip grafting are the best methods; and if the operation is performed in a close case, not one in twenty will fail if young wood in an almost herbaceous state be operated on. I have grafted seedlings when only an inch or two in height on cuttings as stocks plunged in a close case, and so treated seedlings flower a month or two earlier than when left on their own roots. If the leaves of the graft are large, clip them through the centre. *F. procumbens*, *F. microphylla*, and other delicate or slender kinds, may be worked on strong-rooting cuttings, or several varieties may be worked on the same stock. A correspondent of the 'Gardeners' Chronicle' mentions that he grafted Fuchsias as long ago as 1844.

The Orchid Family (*Orchidaceæ*).*

We have here a large natural group, comprising some four or five thousand perennial evergreen or herbaceous. plants, distributed over nearly every part of both hemispheres. For practical purposes, they are divided into terrestrial kinds, which are for the most part deciduous or herbaceous tuberous-rooted species, found in temperate regions; and epiphytal species, or such as grow upon trees, sending both roots and growth into the air, as in *Denbrobium*, *Angræcum*, some *Odontoglots*, as *O. Alexandræ*, *O. Pescatorei*, &c., *Cypripediums*, as *C. Lowii*, *Aerides* or "air-plants," *Vanda*, *Renanthera*, and many others, nearly all natives of hot, moist regions in Asia and South America—a few coming from moist parts of tropical Africa. Many Orchids, and more especially species of *Vanda*, *Aerides*, *Phalænopsis*, *Angræcum*, *Cattleya*, *Oncidium*, and *Saccolabium*, are noted as being amongst the most rare and beautiful of all tropical flowers; and of late years they, and others, have occupied prominent positions in our gardens here at home. Many species have thickened stems or pseudo-bulbs, these being formed by the cohesion of the thickened leaf-stalks or petioles, and their use is to serve as reservoirs of nutriment, so as to enable the plant to withstand the hot and dry or rainless period of the year in its native habitat; and this thickening of the growth is somewhat analogous to the succulence of *Cacti*, different species of *Euphorbia*, *Sedum*, *Sempervivum*, *Echeveria*, and other plants, and it enables them to resist periods of unsuitable climatic conditions, and at the same time retain their permanent or evergreen character. In their native habitats, Orchids are naturally multiplied by seeds; and the fertilisation of a very large proportion of them is dependent on insect agency. This also accounts for the extreme variability of some species of *Phalænopsis*, *Odontoglossum*, and *Cattleya*—different forms, and probably different species, becoming fertilised with the pollen of other species or varieties. Thus, *Phalænopsis Veitchiana* is supposed to be a natural mule between *P.* (*equestris*) *rosea* and *P. Schilleriana*. In alluding to supposed natural hybrids in the 'Gardener's Chronicle' (March 6) 1875, p. 301-2, Prof. Reichenbach remarks that *Phalænopsis*

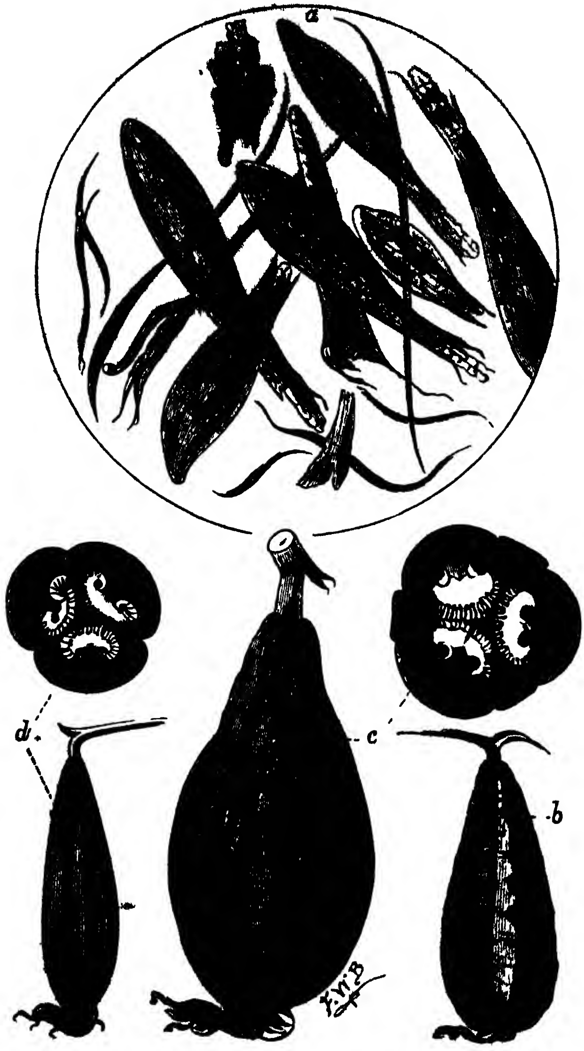
* The reader interested in the cross-fertilisation of Orchids should see Darwin's work, 'On the various contrivances by which British and Foreign Orchids are Fertilised by Insects, and on the good effects of Intercrossing' (Murray); also, 'Experiments on the Fertilisation of Orchids in the Royal Botanic Garden of Edinburgh' (Scott).

intermedia, Lindl. (see 'Paxt. Fl. Gard.' iii. fig. 310), may be a hybrid between "*P. Schilleriana* as the male and *P. amabilis* as the female," while *P. leucorrhoda* appears to be a reversed mule between the same parent plants. *Odontoglossum Coradinei* is by Prof. Reichenbach (see 'Gard. Chron.,' 1872, p. 1068) supposed to be a natural hybrid between *O. triumphans* and *O. odoratum*, or some nearly-allied species. *O. Murrellianum* (see 'Gard. Chron.,' 1875) is another supposed natural hybrid, intermediate between *O. Pescatorei* and *O. nævium*. *O. Humeanum* (see 'Gard. Chron.,' 1876, p. 170) is seemingly intermediate between *O. cordatum* and *O. Rossii*; and Prof. Reichenbach assumes that it is a natural hybrid between these two species. If the last-named species are found associated in the locality whence *O. Humeanum* was imported, it is quite possible that this view of the case is a correct one; but it would be a more satisfactory solution of the question if Mr Seden, or some other equally clever hybridist, would cross the two (supposed) parent species, and raise us a batch of *O. Humeanum*.

The majority of Orchids are very readily multiplied; still there are some that can only be propagated at long intervals. The value of an Orchid depends not only on the beauty of the plant or its flowers, but also on the small quantity imported, or the difficulty of its being multiplied in our collections. Dendrobiums are perhaps as easy to propagate as any other Orchids. The old flowering-bulbs of *D. nobile* may be cut into lengths, the latter being inserted in a common cutting-pan, covering them with a bell-glass, and plunging them in bottom-heat. So treated, they break freely. *D. Devonianum*, *D. transparens*, and many others, may be propagated in a similar manner; or the old bulbs may be twisted round the tops of the pots and pegged down among the sphagnum. It is a good plan to have a close case in the Orchid-house, the bottom being covered with a layer of living sphagnum. Then, as back bulbs are cut from the plants, they should be labelled and laid on the moss, which should be watered or syringed occasionally to keep it fresh and moist. Nearly all Orchids will break freely from the old bulbs in a close humid atmosphere, provided always that there are latent buds on the parts removed. Old back bulbs of *Oncidiums*, *Odontoglossums*, *Zygopetalums*, *Miltonias*, *Maxillarias*, and *Lycastes*, may be placed in a cutting-pan, or laid on a layer of moss in a warm, moist situation, where a large proportion of them will root and break freely. *Aerides*, *Vandas*, and *Saccolabiums* can only be propagated by lateral breaks. These last are produced very freely by some strong imported plants that have accident-

ally lost their leading growth. The same remark applies to *Camarotis*—a beautiful, though neglected, old Orchid—and to the *Angræcums*. *Thunia alba* and *T. Bensoniæ* are very easily multiplied by cutting up the old pseudo-bulbs into pieces, 3 to 4 inches long, and treating them as recommended for Dendrobiums. *Phalænopsis* often produce lateral breaks, and occasionally young plants on the flower-stems. *P. Luddemanniana* frequently does this; while *Cypripediums Masdevallias*, *Disas*, and most other Orchids, are readily multiplied by division after the plants have attained to a good size. *Calanthes* are very easy to propagate, for if an old bulb has its top broken off, it will often produce two or three young plants round the fracture, or the old flowering-bulbs may be cut into lengths and inserted in white sand; and thus treated, every piece will produce buds and roots, while the base should be left to develop itself as usual. The delicate little *Pleione humilis* propagates itself very freely, producing numerous little bulbils on the apex of its old decaying pseudo-bulbs. These fall off and root freely into the living sphagnum on the pot-tops. The preceding methods are those generally adopted in the nursery trade, and are equally applicable to private establishments.

There is nothing particularly difficult in the mere mechanical operation of fertilising Orchids; for, in the generality of cases, the pollen has only to be applied to the stigma in order to induce fruitfulness. It may, however, be as well to note that both the pollen and stigma vary in structure and general conformation from those of most other plants. The pollen-masses are of a waxy consistence, and may be reached by removing the little cap (anther) at the end of the column. The stigma, or stigmatic surface as it is generally called, lies immediately beneath the apex of the column, and is often of considerable size. Any small point, such as that of a quill toothpick, may be used to remove the pollen, and to place it in a stigmatic cavity. The pollen-masses of some genera are furnished with a viscid or gummy disc, which readily adheres to the point used. Those, however, of some Orchids, such as Cattleyas, and especially Dendrobiums, will not readily do so; but to obviate any little difficulty this may occasion, insert your toothpick into the stigmatic cavity, when it will become coated with the viscid matter or mucus therein contained, and to which the pollen-masses will readily adhere, no matter how dry and glossy they may be. In a few hours after the flower is fertilised, it commences to wither, and an interesting change takes place with regard to the stigmatic cavity. This cavity



a, Phalænopsis seeds (magnified), b, Fruit of Aërides crispum Warneri, c, Fruit of Dendrobium nobile, d, Fruit of Phaius albus

is widely distended previous to fertilisation; but as soon as that actually takes place, the sides begin to contract, and finally close in, in some cases even overlapping, and thus effectually preventing the possibility of the pollen being removed by insect or other agency, or becoming damaged by water or other foreign body coming in contact with it. The ovary enlarges rapidly after fertilisation; the capsules of Phalænopsis, which are rarely half an inch long before, attain a length of from 4 to 6 inches, and the thickness of the little finger, in about sixty days after that has taken place, and contain many hundreds of minute ovules. The great difficulty, however, does not lie in the mere fertilisation, but in obtaining a fair percentage of seedlings. The structure of Orchid seeds is nearly the same as those of Burmanniads and Pyrolads or Winter Greens; they consist of one or more finely-netted or cellular hygrometrical coats of an oblong form, something like an old-fashioned chain purse, while the nucleus may be likened to a small rounded or oblong gold coin inside. The seed-coats are transparent in nearly all the species, if we except Vanilla, where they are more dense and scobiform, like those of Nepenthes in colour, and perfectly opaque. Seen under the microscope, the seeds of most Orchids form beautiful objects. It is generally thought that all Orchids are epiphytal in their earliest stages of germination; hence the desirability of sowing their seeds on living moss or other vegetation, which will supply moisture regularly to their hygrometrical tissues. As before mentioned, it is requisite for the parent plant to be in the highest state of health, in order to produce seed in good condition. In order to favour the production of well-developed seeds as much as possible, the hybridiser should be content to take only a small quantity from each seed-parent, however vigorous it may be. I have repeatedly noted in the course of my own experiments that one pod on a vigorous Cattleya or Phalænopsis is quite sufficient to stop the growth of the foliage for a whole season; and this does not appear so surprising when we consider that each capsule contains thousands of hungry little ovules, which collectively require a deal of nourishment.*

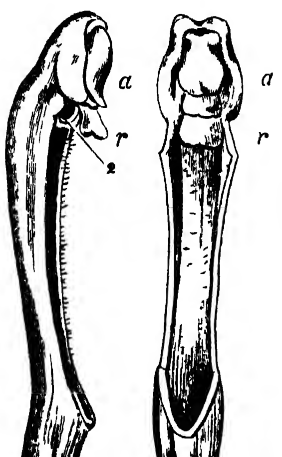
After many careful experiments, I have come to the conclusion that perfect seeds are produced much more rarely than is generally supposed; indeed, I believe Orchids produce good seed but very seldom, especially if more than one capsule is left on a plant, and to this may be attributed the many failures

* Valuable notes on the structure and germination of Orchid seeds are given in 'Beitrage zur Morphologie und Biologie der Familie der Orchideen,' by M. J. G. Beer. (See also 'Revue Horticole,' 1872, p. 244 and 331.)

that cultivators have experienced in their attempts to raise hybrids. When Orchid seeds are obtained, they should be examined under a good microscope; if they are perfect, the nucleus ought to be seen beneath the translucent, membranous, reticulated testa or seed-coat. If the nucleus is not developed, it is useless to expect germination to take place; we might as well expect to obtain a batch of young Ferns after having sown the empty spore-cases, which last is far from being an uncommon occurrence. Not forgetting what has already been achieved in the way of hybrids, it will be generally admitted that as cultivators we have still much to learn, in so far as the raising of Orchids from seed is concerned. That which has already been done in this direction, and a glance at our complete list of hybrids, ought to induce those who have the opportunity to undertake more extended researches. Two growers at least have succeeded in rearing seedling plants of the beautiful and rare *Cypripedium* (*Selenipedium*) *Schlimii*—viz., M. Leroy, Passy (France), and Mr Pilcher, gardener to S. Rucker, Esq. of Wandsworth. Perhaps the most brilliant success has attended the patience and perseverance of Mr Dominy, of the Royal Exotic Nursery, Chelsea, who has succeeded in crossing several genera, amongst which may be mentioned Cattleya with Lælia, Phaius with Calanthe, and Calanthe with Limatodes.

Disa grandiflora comes up from seed very freely, and some of the beautiful varieties into which it sports have doubtless originated in this manner. Disas and Cypripediums are obtained from seed quicker than any other Orchids. Cattleya seeds also germinate well; but the perfection of the seedling plants is effected very slowly. Orchid seed when obtained should be sown immediately on some fresh living sphagnum in a moist situation, where there is no danger of its being disturbed for twelve months at least. After the seed is sown, it should never be allowed to become dry, for on this depends all hope of success. Even after the seed does germinate, it takes the seedlings a long time to make flowering plants; still the raising of seedling Orchids is very interesting for those who have the leisure and inclination to devote to the subject. Only a few genera have as yet been operated on successfully by the hybridiser—Chysis, Dendrobium, Cattleya, Cypripedium, Goodyera, Phaius, Calanthe, Lælia, Anæctochilus, Aërides, and Limatodes being all. There would appear to be a natural affinity between Calanthe and Phaius, seeing that they cross most readily, although botanically one belongs to the Vandæ and the other to the Epidendreæ.

Vanilla.*—Orchidaceous Plants from the West Indies and tropical America, of scandent habit, easily propagated by division. *V. planifolia* yields the "vanilla" of commerce, one of the rarest and most valuable of spices. Dr Morren of Liege was the first to prove, experimentally, that the fruit of Vanilla may be produced as freely in our own hothouses as in Mexico. In the year 1836, a plant in the Botanic Garden of Liege produced fifty-four flowers, which, being artificially fecundated, produced the same number of pods equal to those brought from Mexico. In 1837, a fresh crop of about one hundred was obtained from another plant, by the same means. He attributes the fecundation of the plants in Mexico to the action of some insect which frequents the flowers, and hence accounts for the non-production of fruits in those plants which have been introduced into other countries.



Column of Vanilla flower, front and side views. a, Anther-case; r, Rostellum; 2, Stigmatic cavity.

This plant has fruited freely in the stoves at Osberton, Notts, and Mr Bennett thus describes his method of procedure: "I attribute failure in the blooming to not getting the wood well matured, for if it is not well hardened it will not flower freely. I allow my plant at times to get almost dry and parched." The failure in the production of fruit arises from a want of knowledge of the art of fertilising the stigma, an operation which requires both care and skill. In the flowers of the Vanilla, besides the sepals and petals, there is the column which bears the anther and stigma. The anther (*a*) is a dilated appendage attached to the summit of the column (clinandrium) by a narrow curved neck, and contains the pollen-masses (pollinia) within a cavity on its lower surface. This appendage, by means of its curved neck, bends downwards towards the lower surface of the column, where it rests upon an organ called the rostellum (*r*), interposed between the

* See a paper "On the Cultivation of Vanilla in Mauritius," by John Horne, communicated by Dr Hooker to the 'Jour. Hort. Soc.,' vol. ii. (New Series), p. 61.

anther and the stigmatic surface (2), which latter lies immediately under the rostellum, and terminates the bearded glandular process which covers the lower surface of the column. The rostellum, which is concave towards the stigma, effectually prevents all contact between that and the anther, and it is therefore necessary to remove it. This is best effected by means of a pair of narrow-pointed forceps, which should be carefully introduced sideways between the anther and stigma, so as to seize the rostellum and tear it off in the direction of the anther. The pollen-masses are then drawn out and pressed down on the stigmatic surface, and the operation is completed. If this is properly performed, the setting is certain. The fruit takes about twelve months to mature, and when full-grown, should be tied at the point with a bit of matting to prevent the pods splitting and losing their grateful aroma.

*Hybrid Orchids.**—It is now nearly twenty years since Mr Dominy, the well-known manager of the plant department of Messrs Veitch & Sons' Nursery at Chelsea, turned his attention to the hybridisation of Orchids, and this was not at Chelsea, as many suppose, but in Messrs Veitch's establishment at Exeter. Mr Dominy's attention was drawn to this subject by Dr Harris of Exeter, and the first hybrid Orchid raised was *Calanthe Dominii* (see 'Bot. Mag.,' t. 5042), for the production of which Mr Dominy received the Medal of the Exeter and Devon Horticultural Society. Since then he has been most successful in the production of hybrid Orchids and other rare plants; and we need only allude to *Cattleya Exoniensis* and *Calanthe Veitchii* as illustrative examples, these being not only the best of hybrid Orchids, but also two of the best of all Orchids at present in cultivation. It must be remembered that when the fertilisation of Orchids commenced at the Exeter establishment, comparatively little was known on the subject. Francis Bauer had made microscopic drawings of the structure and formation of many curious Orchid flowers, but these were not distributed or so accessible as now. Darwin's work was not written until Mr Dominy had made considerable progress with hybridising Orchids, and had acquired a large amount of practical experience as to the best way of treating their minute sawdust-like seeds in order to insure germination. It must be borne in mind that Orchid seeds do not germinate so readily as those of most other plants, and it is often years before the little seedlings are discerned peeping out of the living sphagnum on which

* "I would once more declare that the raising of such hybrids [Orchids], whose origin is candidly and clearly stated, must by-and-by assist us very much in improving our views about species."—H. G. REICHENBACH.

they were sown. Some of these hybrid plants which now delight us with their glowing colours and grateful fragrance have been watched and tended for a dozen years or more before the anxious cultivator has been rewarded with the sight of their first blossoms, and then many of them have been found worthless, or nearly so; for it must not be supposed that every hybrid obtained has been so valuable, either from a floral or scientific point of view, as those we here enumerate.

One remarkable fact in connection with these hybrids is their intermediate nature, this being so obvious in many cases that any Orchid-grower could easily guess the names of their parents directly he saw the hybrids in flower. In Mr Seden's Lady's Slipper (*Cypripedium Sedeni*) we have one of the best-authenticated instances of perfect reciprocity of fertilisation. This hybrid was produced by crossing *C. Schlimmii* with pollen from *C. longifolium* (*C. Reichenbachianum*, Hort. Bull); and another batch of seedlings in which this cross was reversed, *C. longifolium* having been made the seed-parent, gave plants precisely similar in every way. From a scientific point of view the crosses effected not only between distinct species, but also between supposed genera, have taught us much. Lælias and Cattleyas cross with each other as freely as species of either genus, and the same remark holds good with Phaius and the deciduous section of Calanthe. This, in our opinion, fully bears out the views of Professor Reichenbach, who does not consider the numerical arrangement of the pollen-masses a character sufficient to separate Cattleyas from Lælias. The cross-fertilisation or hybridisation of Orchids by man's agency is as yet in its infancy, while insects have unconsciously carried pollen from flower to flower for ages past, thus adding much to the perplexity of modern botanists, and to the delight of all lovers of the beautiful. In performing experiments for all intelligent purposes, Orchids and Asclepiads, which have wax-like pollen, are peculiarly well adapted, since the danger of accidental or self-fertilisation is here reduced to a minimum.

Hybrid Orchids.

Cattleyas.

Hybrid.	Parents.	
C. Exoniensis,	C. Mossiæ,	× Lælia purpurata.
C. Dominiana,	C. amethystina	× C. maxima.
C. Dominiana alba,	C. amethystina	× C. maxima.
C. Dominiana lutea,	C. amethystina	× C. maxima.
C. hybrida,	C. granulosa	× C. Harrisonii.
C. Sidneana,	C. crispa	× C. granulosa.
C. Brabantiæ,	C. Loddigesii	× C. Aclandiæ.

C. quinquecolor,..........C. Aclandiæ	×	C. Forbesii.
C. Devoniensis,..........C. crispa	×	C. guttata.
C. Manglesii,..............C. Mossiæ	×	C. Loddigesii.
C. Veitchii,................C. crispa	×	C. labiata.
C. hybrida maculata, ...C. guttata	×	C. intermedia.
C. Fausta,.................C. Loddigesii	×	C. Exoniensis.

Cypripediums.

C. Dominianum,...........C. Pearcei	×	C. caudatum.
C. Harrissianum, ...C. barbatum	×	C. villosum.
C. vexillarium, ...C. barbatum	×	C. Fairreanum.
C. Sedeni, ...C. Schlimmii	×	C. longifolium.
C. Arthurianum,..........C. Fairreanum	×	C. insigne.
C. Marshallianum, ...C. concolor	×	C. venustum pardinum.
C. selligerum, ...C. lævigatum	×	C. barbatum.
C. hybridum, ...C. Stonei	×	C. barbatum.
C. tessellatum, ...C. concolor	×	C. barbatum.
C. Ashburtoniæ,..........C. insigne	×	C. barbatum.
C. euryandrum,*..........C. Stonei ♂	×	C. barbatum ♀.
C. Crossianum,†..........C. venustum	×	C. insigne.
C. œnanthum,............ C. Harrissianum	×	C. Stoneii.
C. marmorophyllum,... C. Hookeriæ	×	C. barbatum.
C. Swanianum, ...C. Dayanum	×	C. barbatum.
C. superciliare, ...C. superbiens	×	C. barbatum.
C. pycnopterum, ...C. barbatum	×?	C. Lowii.

MISCELLANEOUS.

Calanthe Veitchii,‡............C. vestita ♂	×	Limatodes rosea ♀.
Calanthe Dominii,§ .... .C. masuca	×	C. furcata.
Phaius irroratus,...... .. ..P. grandiflora	×	C. Veitchii.
Anæctochilus Dominii,........A. xanthophyllus	×	G. discolor.
Goodyera Veitchii, ...G. discolor	×	A. Veitchii.
Goodyera Dominii, ...A. Lowii	×	G. discolor.
Aerides hybridum, ... A. affine	×	A. Fieldingi.
Lælia Pilcherii,‖................L. Perrinii ♀	×	C. crispa ♂.
Lælia alba,.......................L. Perrinii	×	C. crispa.
Dendrobium Dominii,.........D. nobile	×	D. moniliforme.
Lælia flammea,¶ ....L. cinnabarina	×	L. Pilcherii.
Zygopetalum Sedeni, ...Z. maxillare	×	Z. Mackayi.
Chysis Chelsoni,................C. bractescens	×	C. Liminghei.
Dendrobium Ainsworthii,** D. nobile	×	D. heterocarpum.
Dendrobium endocharis,......D. heterocarpum	×	D. moniliforme.
Dendrobium rhodostoma.....D. sanguinolentum	×	D. Huttonii.

* Gard. Chron., 1875, p. 772.

† Gard. Chron., 1873, p. 877. This plant is similar to *C. Ashburtoniæ*, and was a seedling in the same batch. It must not be confounded with *C. Crossii*, a variety of *C. barbatum*.

‡ Bot. Mag., t. 5375.

§ Bot. Mag., t. 5042.

‖ See Fl. Mag., t. 340.

¶ Florist, 1874, p. 133.

** Florist, 1874, p. 113; Floral Magazine (N.S.), t. 196. This hybrid is the result of seeds sown in March 1867, on a moss-covered block of wood, and it flowered for the first time on February 1, 1874.

Cypripedium Harrissianum is a fertile hybrid—that is, it has borne good seed when fertilised with pollen from *C. Stonei*, a batch of seedlings raised by Messrs Veitch between these two parents showing great diversity of habit; and one of these—*C. œnanthum*, above mentioned—has already flowered. At first sight one would say that it had the greatest resemblance to its female parent; but there is abundant evidence of the influence of the male parent. The lip is exactly that of *C. Harrissianum*, and the petals also, with the exception of a few purple spots at the base; then the upper sepal has more white at its apex, and there is just a flush of vinous purple on its upper half, while the greenish base is spotted with brown, much in the way of *C. insigne*. The lower sepal is pale green, also spotted with brown; so that we find very little of *C. Stonei* in the flower itself, if we except the vinous suffusion on the upper sepal. Passing from the flower, however, we find the ovary exactly like that of *C. Stonei*—viz., pale green, with broad purple lines; but instead of its being glabrous, it is clothed with purple hairs. The scape itself is that of *C. Harrissianum*. The handsome leaves are intermediate, but approach *C. Stonei* in being slightly glossy, and in having a sharp keel behind. They are, however, shorter, and this greatly alters their appearance by making them look broader; and, moreover, there is just a suspicion of the markings of a marbled leaf, while at the base we have the characteristic dotting as seen at the base of the leaves of the grandfather, *C. villosum*. If the other hybrid Lady Slippers are fertile, as we may now reasonably suppose, the production of varieties innumerable is but an affair of time. Prof. Reichenbach assumes that *C. insigne Maulei* is one of the parents of this hybrid, and not *C. Stonei*.

Phaius inquilinus is a garden hybrid raised in the nurseries of Messrs Veitch & Sons, but unfortunately the records of its parentage are lost (see 'Gard. Chron.,' 1867, p. 544).

The Wood-Sorrel Family (*Oxalidaceæ*).

This is a small natural group of herbaceous plants or small shrubs, principally natives of the Cape of Good Hope and South America, and a few species inhabit the temperate parts of Asia and Europe. They are nearly related to Geraniaceæ, from which they may be distinguished by their beakless fruit. Many species are grown in gardens as ornamental plants, and some of the tuberous-rooted South American species, as *O. crenata*, *O. Deppei*, and others, produce edible tubers, which may be used like Potatoes; but their culture is not general.

One or two species have sensitive leaves, and this is especially noticeable in *O. sensitiva* and our native *O. acetosella*, as well as in *O. stricta*. Nearly all the species seed freely; some, indeed, like *O. corniculata*, become weeds in our hothouses and gardens. Sow as soon as ripe, the tender species in heat, and the hardy species in a sheltered border, where they will be safe from birds and mice. The tuberous-rooted kinds are readily multiplied by dividing old plants. Little or nothing appears to have been done to improve these plants by artificial hybridisation, which is much to be wondered at, considering their beauty and easy culture. The pollen is ripe soon after the expansion of the flowers, and the two sets of stamens seem intended to facilitate cross-fertilisation. The elasticity of the capsules is a little singular, the seeds being suddenly thrown out by the contractibility of the lining of the ripe carpels. This, like similar arrangements in Balsams, Mormordica, Broom, and other plants, seems intended to distribute the seeds, and is one of the most potent of nature's methods of securing a rotation of crops. The seeds are beautifully pitted, and form pretty microscopic objects under a low power.

THE PALM FAMILY (*Palmaceæ*).

A natural and extensive family of hard-leaved plants, principally natives of tropical and intertropical countries, where they vary in height from only a few inches to one or even two hundred feet. In South America, and especially in the Amazon and Orinoco valleys, Palms of very diverse habits are found in large numbers. Wax, oil, wine, flour, sugar, and salt are afforded by these plants, together with leaves for thatch, fibre, and writing materials. One of the best-known imports produced by this family is sago, which is prepared from the stem-tissues or pith of *Sagus lævis* and *S. genuina*, both cultivated largely in the Moluccas, each individual furnishing seven to eight cwt. of prepared starch or sago. *Caryota urens*, *Phœnix farinifera*, and other Palms, yield inferior sago. *Phœnix dactylifera* is the Date-palm, and oil is largely produced from the fruit of the Oil-palm—*Elais guinensis*—and also from the Cocoa-nut Palm—*Cocos nucifera*; while the Wax-palm—*Ceroxylon andicola*—affords a kind of wax or sperm of considerable economic importance in the manufacture of soap and candles. Nearly all the species, which number upwards of seven hundred, are graceful in habit, having fresh, glossy, evergreen leaves, which, being hard and permanent, render these plants eminently useful as decorative plants. Popularly they are divided into Fan-

leaved and Pinnate-leaved groups; and it is a little singular to note their present popularity in our gardens, when we remember that ten years ago a Palm was scarcely to be found in England, except in our great botanical or other public gardens. All Palms are readily propagated by sowing imported seeds in a heat of 80° to 90°, taking care not to supply moisture too liberally until germination commences. Few Palms will germinate in a low temperature; but in this respect the Date-palm appears to be one of the hardiest, as its seeds germinate in a sitting-room window, and it can be readily raised by sowing the Date-stones of the shops. The best plan is to sow the seeds as soon as they are received on a genial bottom-heat in a high temperature. *Cocos Weddelliana* bore fertile seeds at Manley Hall, Manchester, in 1871-72, and it has also done so since elsewhere. The cæspitose species, as *Rhapis*, may be multiplied by division; but seeds are to be preferred in all cases where attainable.

It is rather singular that none of our lynx-eyed propagators have succeeded in hybridising Palms. Their bisexual flowers would rather facilitate cross-breeding than otherwise: and if fruit-bearing plants can be procured of *Cocos Weddelliana*, *Chamærops humilis*, *Calamus ciliaris*, or any of the dwarf-growing species of *Geonoma*, *Areca*, or *Chamædora*, pollen could in most cases be procured from such allied species or genera as continue flowering nearly all the year round in one or other of our great botanic or public gardens.

A hybrid Palm was grown by M. Denis, Hyères, and was obtained by fertilising *Chamærops humilis*, var. *arborescens*, with pollen of the Date-palm—*Phœnix dactlyifera.* The leaves are described as being like those of the male parent, as are also the small, ovate, Date-like fruits. The seed, however, occupies nearly the whole of the interior of the fruit, is rounded in form, not grooved, as in the Date, and the embryo, instead of being in the centre, is at one end of the hard albumen. It would be very interesting to know if progeny of this hybrid are in existence.

THE SCREW-PINE FAMILY (*Pandanaceæ*).

A small family of tropical plants, having for the most part sword-shaped, sharply serrate leaves, curiously arranged in a spiral or screw-like manner, on a more or less woody stem, the latter being often supported several feet above the surface of the earth by stout buttress-like roots. The flowers are borne on a wholly-covered spadix, and are either unisexual or polygamous. They are most abundant in the tropical islands of

the Old World, especially in the Isle of France. *Pandanus*, *Freycinetia*, and *Carludovica* are the principal genera of this family represented in our gardens. Imported seeds germinate readily if treated like those of the tropical Palms. In cultivation, however, offsets or breaks from near the base or root-stock of the plant are resorted to, these being taken off with a slice of the old bark and rooted in a close case, like cuttings of endogenous plants. In the case of *Pandanus*, cuttings of the fleshy root, if placed on a hotbed or in a close heated case, often develop adventitious buds, and so produce young plants. If there is any difficulty in obtaining offsets, the central growth of the plant may be destroyed or checked, so as to facilitate the development of the lateral buds, as recommended in the case of Bromeliads.

The Poppy Family (*Papaveraceæ*).

A rather large group of annuals or herbaceous plants, often characterised by a milky juice. Lindley says they are unknown within the tropics in a wild state. Two species are peculiar to Siberia, three to China and Japan, one is found at the Cape, and six or eight are natives of America. These plants are represented by the following genera in our gardens: *Bocconia*, *Chelidonium*, *Argemone*, *Meconopsis*, *Papaver*, *Glaucium*, *Eschscholtzia*, and *Romneya*. Poppies are well known both in corn-fields and gardens. *Romneya Coulterii* is a large white-flowered Californian annual of remarkable beauty and fragrance. The Indian species of *Meconopsis* are very handsome. The only species of important economic use is the Opium Poppy—*Papaver somniferum*—the native country of which is unknown. Nearly all the species produce seeds in great abundance, and these grow freely sown in a gentle bottom-heat. The Californian and European annuals may be sown in the open air in May or June.

Papaver (*Poppies*).—A group of showy annual or herbaceous plants, readily propagated by seeds, which germinate if sown in the open border or flower-beds in spring. *P. bracteatum*, *P. orientale*, *P. nudicaule*, *P. somniferum*, and others, are cultivated in our gardens, and as might be inferred from their extreme multiplicity of stamens, double-flowered varieties are common. A hybrid has been raised between *P. bracteatum* and *P. orientale*, as also one between *P. orientale* and *P. somniferum*.* *P. bracteatum* has also been fertilised with pollen from *P. Rhœas*, the result being a dwarf hybrid

* Revue Hort., 1863, p. 333.

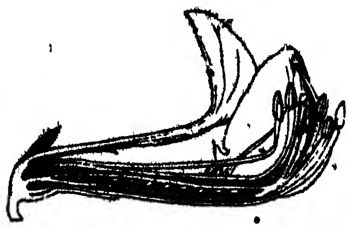
known in Continental gradens as *P. hybridum meldense;* and the union of *P. bracteatum* and *P. somniferum* has produced a race of showy garden plants. The hybrid between *P. orientale* and *P. somniferum* was known to Linnæus; and the fact is noted in the 'Journal de Physique,' t. xxxii., p. 459: "I have seen in the Botanic Garden, Edinburgh, a hybrid plant produced by the Oriental Poppy and the Opium Poppy. The stamens were removed from the flowers of *P. somniferum* just before they expanded, the stamens of *P. orientale* being placed on the stigmas after they became well developed. This experiment was repeated several years with equal success."

THE PEA FAMILY (*Papilionaceæ*).

A large group of plants, for the most part readily recognised by their irregular Pea-like flowers, while some of the species are among the most nutritious of all our food-plants. The principal genera in our gardens are *Baptisia*, *Brachysema*, *Gompholobium*, *Hovea*, *Goodia*, *Lupinus*, *Ulex* (Furze), *Spartium* (Broom), *Genista*, *Laburnum*, *Trifolium* (Clovers), *Ononis* (Rest-harrow), *Indigofera* (Indigo), *Glycyrrhiza* (Liquorice), *Wistaria*, *Robinia*, *Clianthus* (Glory Pea) *Colutea*, *Pisum* (Peas), *Ervum* (Lentils), *Lathyrus* (Sweet-peas), *Orobus*, *Arachis* (Pea-nuts), *Coronilla*, *Desmodium*, *Hedysarum*, *Erythrina*, *Phaseolus* (Scarlet-runner), *Dolichos*, *Abrus* (Crabs'-eyes), *Sophara*, *Virgilia*, *Cassia*, *Brownea*, *Amherstia*, *Jonesia*, *Bauhinia*, *Cercis*, *Acacia*, *Faba* (Beans), and others. They are distributed over nearly every part of the earth's surface, many being annuals, while the Acacias, Robinias, and others, are large trees; many others being either herbaceous plants, as Lupins, or scandent undershrubs, as *Kennedya* and *Hardenbergia*. As a rule, all the species produce fertile seeds freely, and in most cases these germinate if sown as soon as ripe in autumn, or in the following spring. The herbaceous perennials are easily increased by seeds or division; and most of the shrubby kinds are propagated successfully from cuttings inserted in heat, or by layers. Grafting is employed for the numerous beautiful varieties of the *Robinia*, the stocks used being seedling plants of *R. pseud-acacia*.

There is a great deal of variation in the structure, arrangement, and curvature of the stamens of papilionaceous or Pea-flowered plants; and this variability seems, in the majority of cases, to favour cross-fertilisation by insect agency. In *Cassia* we have two very long stamens, while the rest are much shorter, and curved, or set at different angles. In *Amherstia*

there are long stamens and almost sessile anthers alternating in the same flower; and I believe this plant has never been known to fruit in this country. The noble specimen in the ducal gardens at Chatsworth might possibly be induced to fruit by carefully cross-fertilising the flowers with pollen from the long or short stamens, particular attention being paid to fertilise at the exact time when the stigma is in a receptive condition.



Longitudinal section (magnified) of the flower of a leguminous plant.

I have not examined the structure in *Jonesia* and *Brownea*, both nearly-allied genera. Apart from the structure and curvature of the sexual organs, the floral envelopes seem in most cases especially constructed and arranged so as to favour cross-fertilisation by insects. This subject has repeatedly, however, been alluded to by different observers, and the reader interested will find notes on the structure and fertilisation of *Indigofera* in the 'Jour. Linn. Soc.,' ix. 327 and 355, and also notes on Dr Hildebrand's paper on *Medicago*, *Indigofera*, and *Cytisus*, published in the 'Botanische Zeitung' (March 1866); and to the same paper a note of Mr Darwin's is appended, on the contrivances by which cross-fertilisation is effected by insect agency in the Common Broom (*Cytisus scoparius*). When we remember the immense diversity of structure and arrangement in this large order, also the variation in colour and odour, Sir John Lubbock's views as to the modifications of flowers by insect agency seem to possess especial weight. Clover depends for fertilisation on bees; and it has been found necessary to send these useful insects out to New Zealand as aids to agriculture. It has been pointed out by Darwin and others that the large humble-bees aid agriculture very much by fertilising Clover, and thus increasing the yield of fertile seeds.

Acacia.—This genus is well known as furnishing many ornamental species, which are largely grown as greenhouse or conservatory shrubs. They belong to the Mimosa section of Papilionaceæ, and bea. globular clusters of bright yellow flowers among their glaucous or bright green phyllodia. *A. armata*, *A. lophanta*, *A. dealbata*, and others, are well-known examples. They are propagated from layers, or imported or home-grown seeds, which, to facilitate their germination, ought to be soaked

in hot water for several hours previous to their being sown, as the seed-coat is very hard and horny in texture. Cuttings of the root are successful in some cases; and *A. armata*, *A. Drum-*

Plant which chiefly yields the gum-arabic (Mimosa arabica), flowering branch (*a*), *and fruit* (*b*).

mondii, and others of the free-growing species, may be multiplied from cuttings of the young growth. *A. dealbata* and its allies, on the other hand, refuse to root from stem-cuttings, and invariably damp off, although layers are more successful.

Amherstia (*Tree of Heaven*).—A showy genus of Pea-flowers, represented in one or two of our gardens only by *A. nobilis*, an Indian or Malayan species, with handsome pinnate leaves like those of a *Brownea*, and bearing great pendent spikes of scarlet golden-eyed flowers. It is slowly increased by cuttings or layers inserted in a genial bottom-heat of 85° to 95°. It is quite possible that cuttings of the roots might develop latent buds, and form plants; or cuttings of the young growth, with the apical halves of their leaves removed to prevent flagging, might be grafted on pieces of the root as a stock, either by

cleft or side grafting, after which they should be potted and plunged in a genial bottom-heated case, with a temperature of 80° to 90°. Circumvallation is the method employed by the Hindoo gardeners, who place the split stem of a Bamboo around a young branch after having girdled it—*i.e.*, removed a ring of bark; and the Bamboo is then filled up with earth, which is kept moist until roots are formed. It might be worth while trying the roots or stems of some species of *Brownea* or *Jonesia* as stocks for this gorgeous plant. Imported seeds lose their vitality ere they reach this country; but home-grown seeds might be more successful, and these might possibly be secured by careful artificial fecundation. Pollen from both sets of anthers should be placed on the stigmas of flowers borne on another inflorescence, and the growth of the pollen might be stimulated by nectar from *Hoya* or other plants.

Brownea.—A small group of tropical trees nearly related to *Amherstia* and *Jonesia*, but more generally found in gardens. One of the most complete collections is in Mr Crawford's garden near Cork. These plants, like the last-named, are rather difficult to propagate from cuttings, either layering or circumvallation being more successful (see *Amherstia*). I am glad to record that seedlings, and in all probability hybrids, have been raised. W. E. Gumbleton, Esq., writing to the 'Garden,' remarks that "Mr Crawford's gardener has succeeded in crossing several of the kinds that have flowered with him, one with the pollen of the other, and has got them to ripen seeds which are of immense size, resembling a very large flat bean, about two only being produced in each pod. These, on being sown, have germinated freely, and he has now an exceedingly nice healthy lot of young seedlings of from the age of a few weeks to several years, whose foliage, in many instances, shows plain indications of partaking of the nature of one or both parents, and from these, when they bloom, some most interesting results may be expected."

Caragana (*Siberian Pea-trees*).—A group of very ornate spring-flowering trees, well worth a place in every garden landscape. *C. arborescens* is perhaps the best-known species, and as it is plentiful, and seeds freely, it forms an excellent stock on which to graft rare or more tender kinds, and especially its own varieties, of which *C. altagana*, *C. chamlagu*, *C. spinosa*, *C. microphylla*, and *C. arenaria* may be cited as examples. *Halimadendron argenteum* also grows well on *C. arborescens* as a stock.

Cytisus.—A group of Pea-flowered plants, represented in our greenhouses by *C. elegans*, *C. racemosa*, and other free-flowering kinds, which are readily propagated either by cuttings or seeds

sown in a gentle heat. The common Laburnum is one of our most beautiful spring-flowering trees, and being principally raised from seed, is very variable in habit. What is known in nurseries as *Waterer's Laburnum* is so much superior to the ordinary Laburnum that it seems inexplicable why it has not been everywhere planted. It is not so large in the foliage nor in the individual flowers as the Scotch Laburnum (*Cytisus alpinus*), although it may possibly be a cross between it and the common sort. Darwin (see 'Animals and Plants,' i. 416) says that "the belief that *Cytisus Adami* is a spontaneously-produced hybrid between *C. laburnum* and *C. purpureus* is supported by the fact that such hybrids have arisen in this genus. In a bed of seedlings from *C. elongatus*, which grew near *C. purpureus*, and was probably fertilised by it through the agency of insects (for these, as I know by experiment, play an important part in the fertilisation of the Laburnum), the sterile hybrid *C. purpureo-elongatus* appeared. Thus also Waterer's Laburnum, *C. alpino-laburnum*, spontaneously appeared, as I am informed by Mr Waterer, in a bed of seedlings." There is a very beautiful golden-leaved variety of Laburnum, which originated as a sport; and this, together with some of the rarer hardy species of this genus, are propagated by grafting or budding on seedlings of the common Laburnum as a stock. Half the seedlings raised are worthless as flowering-plants, and either Waterer's Laburnum or some other good variety should be worked on the seedling stocks, so as to insure good varieties only in cultivation. M. Baltet recommends seedlings of *C. alpinus* as stocks on which to graft in March and April, or propagate by shield-budding in July and August. Seedlings of *Cytisus alpinus* form good stocks for *Genista multiflora*, and seedlings of *G. hispanica* serve for other varieties, cleft-grafting in spring (March or April) being the most successful method. Scions should consist of young growth, with a heel of old wood at the base. All the slender-flowering kinds, as *C. purpurea*, *C. rosea*, *C. alba*, *C. carnea*, *C. elegans*, and *C. trifolia*, are said not to succeed except cleft-grafted at the desired height. The strong-growing kinds, such as *C. Adami*, *C. biflorus*, *C. grandiflorus*, and others of similar habit, are best propagated by budding or grafting close to the ground, as they are vigorous enough to form stems. When the stock is headed off for cleft-grafting, it is essential to the success of the operation that a shoot or bud be left to attract the sap to the scion. Snails are troublesome when the scions are worked near the ground; place quicklime or barley-chaff around the stocks to keep them at bay.

One of the most interesting plants in this genus is the supposed graft hybrid* *C. purpuraceus*, or *C. Adami*, as it is called in some gardens (see Grafting).

Erythrina (*Coral-trees*).—A group of very ornamental shrubs, the species of which are principally natives of the tropics or sub-tropical countries. *E. crista-galli* is one of the oldest and best of the cultivated species; and, together with the hybrids and seminal forms, which have of late years been raised in French and Belgian gardens, most of the species, and especially *E. crista-galli*, *E. herbacea*, *E. laurifolia*, seed freely if cross-fertilised, and the seeds germinate readily sown in February in a genial bottom-heat of 65° to 75°. Cuttings root freely if taken off when the plants break in the spring, and should be inserted in a heated case. M. Duchartre alludes to some of the earliest hybrids (see 'Jour. de la Soc. Imp. et Cent. d'Hort.,' t. vii. p. 81), which, it appears, were raised by M. Bellanger, formerly of Charonne, who commenced operations by fertilising *E. crista-galli* with pollen of *E. herbacea*, the result being three hybrids, not of any special beauty in themselves, but which served as the parents of more beautiful forms. M. Bellanger followed up his experiment by fertilising these hybrids and their seedlings reciprocally with one or other of the two original parents; and in 1855 he succeeded in raising *E.* "Marie Bellanger" from seeds of *E. crista-galli*, fertilised by one of his unnamed seedlings. *E. Bidwellii*, another elegant hybrid, was obtained from seeds of *E. herbacea*, fertilised with pollen of *E. crista-galli*. Many beautiful cross-bred forms are now used in our summer flower-garden arrangements; and by cross-fertilising the best of these, other new and more effective forms are obtainable.

Pisum (*Peas*).—Papilionaceous or Pea-flowered climbing annuals and perennials, easily propagated by seeds, and the perennial section by division. The edible Peas, now so much improved by cross-breeding, and so largely grown in our gardens, have originated from two types—*P. arvense*, a red-flowered annual, commonly known as the "Field-pea," and *P. sativum*, a white-flowered annual, and, like the last-named kind, a native of Southern Europe. Seeds sown in succession enable the gardener to procure this delicious vegetable from May to November in favourable seasons. New or improved varieties are obtained either by the careful selection of seminal varieties or by judiciously crossing any two varieties which individually possess qualities it is desirable to unite in the progeny. The anthers of Peas and many of their allies shed their pollen

* See Herbert's Amaryllidaceæ, p. 376.

before the flowers expand, and this is especially the case with the earliest flowers, so that it is necessary to emasculate the female or seed-bearing parent some days before the bud is ready for opening its petals to the sun, and this is best done by slitting the bud with a keen penknife, after which carefully cut out all the anthers with a pair of sharp-pointed scissors, and if the surface of the stigma is moist or glutinous, apply the pollen from the desired male parent. The pods from fertilised flowers should be labelled with the names of the parents, and need careful protection from birds.

The late Dr Maclean raised some very fine varieties of Peas, his "Advancer" and "Best of all" being two of the best. The late Mr John Standish commenced hybridising Peas in 1869, with the view of obtaining dwarf early marrow-fat varieties, combining the quality of our richly-flavoured marrow-fats with the precocity of our earliest round sorts. With this object in view, he took "Ne Plus Ultra," one of our best but latest marrow Peas, as the female parent, and hybridised it with "Laxton's Supreme," an unquestionably fine second-early pea, but wanting in flavour. In 1870 the selection from the previous year was further crossed with "Climax," an early dwarf marrow-fat, but possessing the disadvantage of not filling the pods well, yet having the rich flavour of the marrow-fats. A selection was again made, and in 1871 these were crossed with Laxton's "Alpha" and Maclean's "Little Gem," and the race of seedling Peas growing this (1875) year at Ascot show that earliness, combined with flavour, has been obtained. The "Criterion" is one of the best of these seedlings. One of the finest of all new Peas is "Dr Maclean," sent out by Mr C. Turner in 1876.

Mr Laxton, of Stamford, has originated a race of very valuable large-podded varieties, and also some dwarf early kinds of great merit, and some of the best of these are included in the following list:—

Alpha.—Blue wrinkled marrow. Raised from Laxton's Prolific, crossed with Maclean's Advancer. 3 to 4 feet.

Supreme.—Early green marrow, the result of a cross between Laxton's Prolific and Little Gem. 3 to 4 feet, very prolific, 8 to 10 peas in a pod.

William the First.—Early green marrow, 4½ to 5 feet high, with habit of the frame class, but related to Prizetaker.

Superlative.—Second early marrow, 7 to 8 feet in height; a cross between Ne Plus Ultra and a variety from Supreme.

Supplanter.—Second early blue, very prolific, a great improvement on Scimitar; a cross between Veitch's Perfection and Little Gem.

Fillbasket.—Second early blue; a cross between Laxton's Standard and Supreme.

Omega.—Late green wrinkled marrow; a cross between Ne Plus Ultra and Veitch's Perfection.

Unique.—Early dwarf green marrow; a cross between Prolific and Little Gem.

Dr Hogg.—Early green wrinkled marrow; the result of a cross between Prolific Long-pod and Little Gem.

Harbinger.—Early round blue; a cross between Alpha and Ringleader.

Robinia (*False Acacias*).—A group of very ornamental North American trees, represented in our gardens by *R. pseud-acacia* and its forms *R. viscosa* and *R. hispida* or "Rose-acacia," the last-named being one of the prettiest of all our summer flowering-shrubs or small trees, and one of which improved varieties might possibly be raised from seeds, if the flowers were carefully cross-fertilised just before they open. Robinias are propagated by layers and by seeds sown in the spring on open-air beds. Grafting may be performed in April—cleft-grafting being the common method in the best nurseries, the common *R. pseud-acacia* from seed being used as a stock. M. Baltet observes: "Slender-wooded kinds, such as *R. tortuosa*, *R. rosea*, *R. linifolia*, and *R. Van Houttei*, should be grafted at the projected height of the branches. The vigorous kinds, *R. Decaisneana*—itself a good stock—*R. unifolia*, and *R. pyramidalis*, may be grafted on the collar of the stock, even when intended for tall standards. The *Robinia* may be taken up and transplanted without injury at the time of grafting. In certain localities it succeeds when budded."

The seminal forms of *Robinia pseud-acacia* are very numerous; and while many form distinct and beautiful trees, others are barely worth notice. They have mainly originated in Continental nurseries. *R. dubia* is said to be a hybrid between the common *R. pseud-acacia* and *R. viscosa.* It forms a middle-sized tree, has short spines on its branches, and bears pale rosy flowers. Its synonyms are *R. hybrida*, *R. ambigua*, and *R. echinata.*

Wistaria.—A very ornamental genus of Chinese, Japanese, or North American Pea-flowered shrubs, of scandent habit. *W.* (*Glycine*) *sinensis* is a well-known and very beautiful spring bloomer, often grown on walls in the south of England as an ornamental climber. There is a fine but rather rare white-flowered variety of the last, and it is even more beautiful than its lilac-flowered parent. Imported seeds grow freely sown in a genial bottom-heat of 60° to 70°; and the young plants

should be gradually hardened off after the young leaves appear. The plant rarely fruits in this country; and this, Mr Meehan thinks, is the result of some deficiency in the supply of food, not that it requires either insect or artificial agency to effect fertilisation. Layers root freely; and to obtain a number of plants, one of the long, slender branches may be layered and a cut made, or the branch girdled at every joint so as to induce it to produce roots, and develop the latent buds at each of the nodes throughout its entire length. A still better and more expeditious plan is to dig up the thick roots and cut them into lengths of 3 to 4 inches, after which plant them in boxes, and place them on a gentle dung-bed or other slight genial bottom-heat, so as to excite vegetation, and aid the production of adventitious buds. Grafting in February or March on thick pieces of its own roots is, however, one of the best possible methods of multiplying this plant. *Sophora* and *Cercis* may also be increased in this manner, or on seedlings of their respective types. The white-flowered variety of *Wistaria* may be grafted on roots of the common or normal form as a stock; but it does equally well on its own roots on warm dry soils, especially if planted near a sunny wall. A double-flowered variety of *W. sinensis* has been imported by Mr James Hogg, a well-known American nurseryman, from Japan, the purplish rosette-like flowers being borne in gracefully drooping clusters, as in the normal form. A figure of this plant will be found in the 'Garden,' ii. 51.

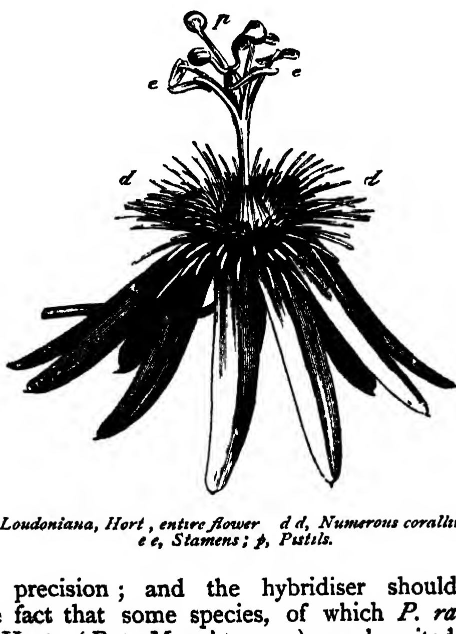
Root-grafting, Wistaria.

THE PASSION-FLOWER FAMILY (*Passifloraceæ*).*

This is a small natural order, represented in our gardens by something like a hundred species and varieties of Passifloras and Tacsonias. They are nearly all climbing plants. The true *Passiflora arborea* is, however, an erect-growing shrub or small tree. All the species may be most easily propagated by herbaceous cuttings, taken off when the plants start into growth in

* For a revision of the species and remarks on germination, fertilisation, movements of reproductive organs, &c., see 'Trans. Linn. Soc.,' 1871, vol. xxvii.

the spring, each having a heel of the old bark. These root readily in sandy soil under a bell-glass, or in a heated case, which must be well ventilated, otherwise they are liable to damp off. Layers, if tongued below a joint, and the part buried beneath any light rich soil, root freely in a few weeks. Seeds are by many species freely produced, and germinate readily if sown in a gentle bottom-heat as soon as ripe., If the seeds are to be preserved, they should be cleaned as recommended for Melons, and sown in the spring. Seedling plants generally bloom the second year. Several species bear eatable fruit not unlike small Melons in shape and flavour, and known by the general name of "Granadillas." One of the best is *P. edulis*, a West Indian species, bearing purple fruits the size of a hen's egg; *P. macrocarpa*, a large-fruited kind, resembling *P. quadrangularis*, and, like the last, bearing large olive-green fruits the size of small oblong Melons. *P. maliformis*, "Sweet Calabash," and *P. laurifolia*, or "Water-lemon," also bear edible fruits. The species of this genus interbreed with



Passiflora Loudoniana, Hort, entire flower d d, Numerous coralline filaments; e e, Stamens; p, Pistils.

tolerable precision; and the hybridiser should bear in mind the fact that some species, of which *P. racemosa* (*P. princeps*, Hort., 'Bot. Mag.,' t. 2001) may be cited as an example; never fruit unless artificially fertilised, owing to their

pollen being impotent, so far as self-impregnation is concerned, although potent when applied to the stigma of other species. M. Delaire, of the Orleans Botanic Garden, long occupied himself in hybridising Passion-flowers; and he was one of the first to record the fact that some species are sterile when their own pollen is used, but fertile when that from another species or variety is applied. *P. amabilis* (see List) is a hybrid obtained by M. Schachter, of Loos-lès, Lille, and is the result of fertilising *P. racemosa* with pollen of *P. alata*. M. Belat, of Moulins, also obtained hybrids in 1847 by fertilising *P. alata* with pollen from *P. cærulea*. *P. Lemichcziana* was obtained before 1845 by M. Lemichez, and is the result of seeds obtained from *P. alata* fertilised with pollen from *P. Raddiana* (*P. kermesina*, Hort.) Pollen of the last-named plant, according to M. Lemichez, will always fertilise the ovules of *P. alata*, and produce a fair percentage of perfect seeds; but the cross cannot be reversed. This is one of the many exceptions to the rule of elective or constitutional affinity as laid down by Wichura (see p. 154). Many of the Passifloras, especially those bearing edible fruits, are widely cultivated in the tropics, especially in South America and the West Indies—so that, what with seminal and cultural variation, together with natural and artificial hybridisation or intercrossing, there are many points in their history rather perplexing to the botanist and horticulturist; and previous to the monograph published by Dr M. S. Masters, the confusion of names was as bad as can well be imagined. *P. cærulea* is perfectly hardy as far north as York, and fruits freely in London gardens, its fruit being of a soft orange-yellow colour, egg-shaped, and generally containing perfect seeds, artificial fertilisation not being necessary.

The following varieties known or supposed to be hybrids are given in Dr Masters's "Classified List of Passifloreæ" (see 'Jour. Royal Hort. Soc.,' iv. 125):—

P. albo-nigra, Regel, 'Gart. Fl.,' 1852, t. 8.—Said to be a cross between *P. alata* and *P. Raddiana*.

P. amabilis, Hort.?—This is said to be a hybrid between *P. racemosa* as the seed-parent and *P. alata*.

P. alato-cærulea, W. Mast. in 'Bot. Reg.,' p. 848.—A hybrid between *P. alata* and *P. cærulea*, raised at Canterbury.

P. "Bijou."—Said to be a hybrid between *P. racemosa* and *P. Raddiana*.

P. Belottii, Hort. Regel., 'Gart. Fl.,' 1852, p. 44; 'Gard. Mag. Bot.,' vol. i.—Said to be a cross between *P. cæruleo-racemosa* and *P. quadrangularis*.

P. Buonapartea, Hort.—Probably a hybrid between *P. alata* and *P. quadrangularis.*

P. cæruleo-racemosa, Sabine, 'Trans. Hort. Soc.,' iv. 9; Lodd. 'Bot. Cab.,' p. 573.—A well-known hybrid between *P. cærulea* and *P. racemosa* (see Herbert's 'Amaryllidaceæ,' p. 354).

P. cærulea-Kermesina.—Probably a cross between *P. cærulea* and *P. Raddiana.*

P. Colvillei, Sw., 'Brit. Fl. Gard.,' ii. 126.—Said to be a hybrid between *P. cærulea* as the male parent and *P. incarnata* as the female.

P. Decaisneana, 'Fl. des Serres,' viii. 848; 'Revue Hort.,' 1855, p. 15.—Said to be a hybrid between *P. quadrangularis* and *P. alata.*

P. Hartwiesiana, Hort. Rollison, is probably a seedling variety of *P. cærulea* with white flowers.

P. hybrida-floribunda, Hort.—Apparently a cross between *P. cærulea* and *P. Raddiana.*

P. Impératrice Eugénie, 'Ill. Hort.,' 1858, p. 175.—Apparently a cross between *P. cærulea* and *P. alata* or *P. quadrangularis.*

P. Innesii, Mast., 'Gard. Chron.,' 1870, p. 891.—A cross between *P. alata* as the female and *P. macrocarpa* as the male parent. This was raised by Mr Munro.

P. Lawsoniana, Mast., 'Gard. Chron.,' 1868, p. 1288.—A cross between *P. racemosa* as the male parent and *P. alata.*

P. Loudoniana, Hort.—Several garden plants exist under this name, but the original *P. Loudoniana* was probably a cross between *P. Raddiana* and *P. racemosa.*

P. Madonna.—Said to be a cross between *P. racemosa* and *P. Buonapartea.*

P. Munroii, Mast., 'Gard. Chron.,' 1868, p. 1288.—A cross between *P. cærulea* as the male and *P. alata* as the female parent. This hybrid, along with several others, was raised by Mr Robertson Munro, of the Lawson Company's Nursery, Edinburgh.

Dr Masters remarks that many seedling and hybrid varieties of the common hardy *P. cærulea* exist; and amongst these he names "angustifolia," "glauca," "imbricata," "alba," and "Neumanni."—Paxt. 'Mag. Bot.,' xv. 270.

P. palmata-cærulea is a hybrid raised in the Jardin des Plantes, Paris, in 1829, by M. Delaire, and is the result of fertilising *P. palmata* with pollen from *P. cærulea*, and is itself fertile, another variety less highly coloured having been raised from its seeds.—(Porcher's 'Du Fuchsia,' 4th ed. p. 29.)

Tacsonia.—A genus of South American climbing plants nearly

related to *Passiflora*, and represented in our gardens by *T. mollissima*, *T. insignis*, *T. Van Volxemii*, and others. All the species are readily raised either from cuttings of the young growth, layers, or seeds. Several cultivators have raised hybrids, all more or less beautiful. The new *T. Exoniensis*, sent out in 1873 by Messrs R. Veitch & Son of Exeter, was raised by Mr John C. Bowring at Larkbeare, Exeter. It is a cross between *T. Van Volxemii*, which was the seed-bearing parent, and *T. mollissima*, the latter being the pollen-parent. It flowered and was described in 1872 (see 'Gard. Chron.' 1872, p. 1653).

Mr Anderson, of the Gardens, Sowerby House, Hull, to whom we owe our first knowledge of the beautiful *T. insignis*, has hybridised that species with *T. Van Volxemii*, the latter being the pollen-parent. We subjoin Mr Anderson's remarks, which are interesting as confirming the fact that Passifloras often set better with foreign pollen than with their own: "*T. insignis* never seeds with me unless it be artificially impregnated, and then not freely with its own pollen, but more so with that of *Van Volxemii*. Out of about forty plants which I raised from two seed-pods, all, with one exception, have the divided leaf of the male parent, while one seems in every respect a true *insignis*."

T. mollissima and *T. Van Volxemii* bear edible fruit, and in this respect they might possibly be much improved by being hybridised reciprocally with the edible-fruited Passion-flowers.

THE MOCK-ORANGE FAMILY (*Philadelphaceæ*).

A small group of deciduous shrubs found scattered throughout Europe, North America, India, and Japan, and represented in our gardens by different species of *Philadelphus* and *Deutzia*. They are nearly allied to *Escallonia*, an evergreen genus readily propagated by cuttings, layers, or seed, just as are the Syringas. All the species are beautiful flowering-shrubs, which bear forcing with impunity; and there is a wide field for further experiments in hybridising and seminal variation and selection, by which these plants may be much improved.

Propagation is readily effected by means of cuttings, either herbaceous or hard-wooded. The latter are made from November to March, in the following manner: The branches are cut into lengths of 10 or 12 inches, which are stuck into free, light sandy soil, and watered when necessary. A good layer of straw over the surface will contribute very much to their

striking successfully. Herbaceous cuttings are made all through the summer, beginning in June or July. Half-ripened shoots are selected for this purpose. The cuttings are stuck into a border of heath-soil, with a northern aspect, or under *cloches* in small pots or in the open ground, where they soon root. Deutzias and Syringas may also be multiplied from seed sown in spring in heath-soil, which must be kept constantly slightly moist by gentle waterings. The seed, being very small, should be very slightly covered with soil, which explains the necessity for frequent waterings. This mode of propagation, however it may fail to exactly reproduce varieties, is desirable when new varieties are sought for. The seed may be sown in pans or pots, which should be placed under a frame, or in a sheltered place in the open air

Deutzia.—A small genus of Japanese hardy shrubs, represented in our gardens by *D. gracilis*, *D. scabra*, *D. crenata*, and one or two other varieties.

There is a very fine and ornamental variety with double flowers, *D. crenata flore-pleno* (which is described and figured in the 'Revue Horticole' for 1867, p. 70). This variety—which, as well as the type, was sent from Japan—has very double flowers, of a fine rosy-flesh colour; they are also extremely numerous and handsome. In habit and vigour of growth, the plant exactly resembles the type, except that the bark of the young shoots is somewhat darker in colour. Another variety, equally fine, is *D. candidissima plena*, the flowers of which are very double, and of the purest white, without the least tinge of rose. It was raised in 1868 by MM. Frœbel & Co., nurserymen, of Zurich, from seed of *D. crenata flore-pleno*. Although quite as vigorous and free-flowering as the parent, it differs from it very much in habit, which almost exactly resembles that of *D. Fortunei*. Seedling Deutzias bearing double white flowers, shaded or tinged with rosy lilac, have been raised by Mr Willison of Whitby; and the plants vary much in habit, being, however, mostly very dwarf and free-flowering.

Philadelphus.—These summer-flowering shrubs are so strikingly beautiful that one could wish for dwarf-growing free-flowering varieties of them for pot-culture or for forcing in the spring like Deutzias. The following varieties have been raised from seed in French gardens:—

P. Keteleerii.—A distinct seminal variety, raised in the Jardin des Plantes by M. Carrière from seed of *P coronarius*. It has semi-double, white, perfumed flowers (see 'Revue Hort.,' 1866, p. 44).

P. tomentosus is also a garden variety raised by M. A. Leroy (see 'Revue Hort.,' 1866, p. 336).

P. amœnus.—This plant is a seedling of *P. speciosus*, remarkable for the abundance and beauty of its flowers.

The Lapageria Family (*Philesiaceæ*).

A small family of ornamental evergreen plants, represented in our gardens by *Lapageria rosea*, its pure white flowered form *L. alba*, and *Philesia buxifolia*, a native of Valdivia, introduced in 1853, *L. rosea* having been imported from Patagonia about 1847-48. Lapagerias are propagated by layers, which should be made of the second year's shoots, twisted around the top of the pot, and pegged beneath the soil, leaving the apex of the shoot above the surface; and if slits or slight abrasures are made near the nodes, the rooting process will be facilitated. Cuttings of Lapageria do not form plants readily. They root in about nine months, but it is essential that ripened growth only be selected. Insert them in boxes of sandy earth in a warm greenhouse temperature. Planted out and trained near the glass, the rosy Lapageria seeds freely, even without artificial fertilisation; but if the operation is carefully performed, both the red and white flowered forms seed freely, and the result is more certain than when impregnation is left to the winds or insects. The fruits are about the size of pigeons' eggs, and occupy nearly a year in swelling and ripening. Mr E. Culley, gardener to E. Salt, Esq. of Ferniehurst, near Bradford, was one of the first cultivators who raised seedlings of the white Lapageria, many of which came true—*i.e.*, like the parent plant—others being intermediate or very pale rose, and others crimson scarlet. Mr Culley's advice is—"Sow the seeds in pots or pans filled with light soil, as soon as the seed-pods are fit to be taken from the plant; place them in a temperature from 60° to 65°, and keep them well soaked with water. They will come up about a month afterwards, and will not then require so much water. If properly treated, they will flower during the second year." Messrs E. G. Henderson and other trade growers also propagate *L. rosea* from seeds—an operation nearly or quite as expeditious as layers, the latter being several months before they produce roots, and they do not grow so freely when first potted as do seedling plants. There are several forms of the rosy-flowered variety in cultivation, and these vary not only in the size and colour of their flowers, but also in foliage, habit of growth,

and in the degree of profuseness with which their flowers are produced. *L. rosea* is quite hardy in Devon, Cornwall, and other southern counties. *Philesia buxifolia* may be propagated by cuttings of the young wood in heat.

Two or three years ago, Messrs Veitch succeeded in producing a hybrid of peculiar interest between *Philesia buxifolia* and *Lapageria rosea*, the latter being the seed-bearing or female parent. This plant is in many respects intermediate between its parents, and is very interesting as a bi-generic hybrid, and one second only in interest to the *Phaius irroratus* raised by Mr Dominy in the same establishment, between the evergreen *Phaius grandifolius* and the pseudo-bulbous deciduous *Calanthe vestita* (see Orchids). This plant has been described and figured in the 'Gardeners' Chronicle' (see volume for 1872, p. 353) by Dr M. T. Masters, under the name of *Philageria Veitchii*, a name which euphoniously indicates the hybrid origin of the plant. I cannot do better than quote the following description from the 'Florist:' "Messrs Veitch's plant is a scrambling shrub, with slender, cylindrical, flexuose, rigid, smooth, wiry branches, having alternate, petiolate, oblong-lanceolate, pointed leaves, about 1¼ in. long by ½ in. broad, leathery, smooth, and dark shining green above, paler and marked by three prominent converging ribs below, and with a cartilaginous very finely serrulated edge. The flower-stalks are axillary, and bear numerous overlapping, ovate-concave, glabrous bracts; and the flower is solitary, pendulous, with a calyx of three fleshy, glaucous, pale rosy-purple, oblong-lanceolate, boat-shaped sepals, and a corolla of an equal number of fleshy, bright, rose-coloured petals, which are slightly unequal in size, overlapping, broadly ovate-acute, with a circular honey-pore on the inner surface at the base. The stamens are six in number, free, hypogynous, or attached at the very base of the segments of the perianth, a little shorter than the petals; the filaments fleshy, subulate, spotted with pink; and the anthers yellow, linear-oblong, tubular at the base, so that the extremity of the filament is concealed at its point of insertion by a kind of sheath. The ovary is 1-celled, with three parietal placentæ, and the numerous ovules are anatropal."

The Plane-Tree Family (*Platanaceæ*).

The Plane-trees of our gardens, and especially of our town gardens, have a natural order to themselves; and we have few nobler trees in cultivation for ornamental purposes. They are

natives of Barbary, N. America, and the Levant, extending even to Cashmere. *Platanus orientalis* or "Oriental Plane" forms a stately, round-headed, spreading tree, and is one of the finest of all shade-trees. *P. occidentalis*, or "Western Plane," is but little inferior, and of much the same general character and habit. There are cultural and selected varieties of each type. They are readily propagated by layering, or by sowing seeds in the autumn or spring in open-air beds. There is no specific distinction between the Eastern and Western Planes, as seedlings of *acerifolia*—the variety of *Platanus occidentalis* generally found in London gardens—often exhibit all the characters of *P. orientalis*. It is singular to note that the variety known as *pyramidalis* is readily propagated from cuttings; while, on the other hand, *acerifolia* cannot easily be propagated in this manner, but is best raised from seed. The ease with which *pyramidalis* is multiplied by cuttings is said (see 'Monatsschrift,' December 1875) to have led to its having become widely diffused through France.

THE PLUMBAGO OR LEADWORT FAMILY (*Plumbaginaceæ*).

A group of very variable plants, many of which inhabit maritime marshes in the basin of the Mediterranean, others being distributed widely in both hemispheres. The best-known examples of this order in our gardens are the *Armeria* (Thrifts), *Statice*, and *Plumbago*—*P. capense*, *P. rosea*, and *P. Larpentæ* being well-known greenhouse plants. The Thrifts are readily increased by careful division or by seeds, and stem-cuttings of *Plumbago* root freely in a gentle bottom-heat under a bell-glass or close shade.

Statice (*Sea-lavender*), a genus of hardy or greenhouse flowering-plants, of which the common "Thrift" is an example. *S. Halfordii* is a well-known example of the greenhouse varieties. All the species are readily propagated by herbaceous cuttings or seed, or the hardy "Thrifts" by careful division of well-established clumps. I am not certain, but it seems probable, that *S. Halfordii*, *S. Frostii*, and several other of the tender kinds, are seedlings or hybrids of the *S. puberula* section. *S. profusa* is well known to be a hybrid production, it having been raised some years ago by an old Scotch gardener named Rattrey, and in Scotch gardens it retains its original name of *S. Rattreyana*. It is the result of a cross effected between *S. puberula*, introduced from Graciosa in 1830, and *S. arborea*, a sub-shrubby species, introduced from Teneriffe in

1829. *S. intermedia* is another pretty hybrid, sent out by M. Belot of Moulins; and the other species, such as *S. Fortunei* and *S. speciosa*, would doubtless well repay the trouble of inter-breeding.

THE PHLOX FAMILY (*Polemoniaceæ*).

A group of ornamental evergreen or herbaceous plants, principally natives of N. and S. America, in temperate latitudes, none being found in the tropics. They are represented in gardens by *Phlox*, *Collomia*, *Gilia*, *Leptosiphon*, *Polemonium*, *Cantua*, and *Cobæa*. Nearly all are readily propagated from seeds, which are freely produced, and germinate readily in heat. The herbaceous section may also be propagated by cuttings and division. Dr Asa Gray, in reviewing the N. American Phloxes, remarks that several kinds appear to be natural hybrids; and this is very interesting, since "many species have been so long cultivated and hybridised that their specific names have given place in many instances to the names by which they are distinguished by horticulturists." The herbaceous Phlox of our gardens, of which we have now so many forms, appears to have descended from *P. decussata*, *P. paniculata*, *P. suffruticosa*, *P. carolina*, and other old species of the tall-growing section. The last named was introduced in 1728, but was soon lost, and its culture may be said to date from 1811 (see 'Bot. Mag.,' t. 1344). It bears large trusses of bright, rosy flowers. *P. divaricata* (also known as *P. canadense*) is a very attractive plant, with bluish lavender-tinted flowers. Seed gathered indiscriminately from a good bed of florists' varieties will give a fair percentage of fine flowers; but in all cases careful crossing is to be advised, as the chances of their improvement are then fully fifty per cent greater. The dwarf-growing section includes some very pretty little species and varieties. *Phlox subulata* (see 'Bot. Mag.,' t. 411). This is a pretty little procumbent rosy-flowered species, introduced from Virginia about 1790. A still earlier plant in this group was *P. setacea* (see 'Bot. Mag.,' t. 415), a native of Carolina, and grown since 1788. Like the last-named plant, this has rosy flowers, with a dark eye. *P. frondosa* and others are well-known dwarf-growing plants; and it is a pity we have not more hybrids and seminal varieties in our gardens, as they are so well adapted for rockwork or for fringing the margins of herbaceous borders. The pretty little white-flowered *P. Nelsonii* is a garden hybrid, raised about twenty years ago by the

late rector of Winterton, Norfolk, after whom it is named. It is said to be the result of a cross between *P. frondosa* and *P. nivalis*. *Phlox reflexa* ('Sw. Brit. Fl. Gard.,' t. 232) is presumably of hybrid origin, and there are numerous intermediates between *P. glaberrina* and *P. carolina*; and *P. procumbens* is by Professor Gray supposed to be a hybrid between *P. subulata* and *P. amœna*, as it is unknown as an indigenous plant. I can find no record of the florists' hybrids; and it is probable that artificial cross-fertilisation has rarely if ever been attempted, seeds having been selected from the best varieties, and cross-breeding having been left to the wind or the bees. There is a good field open here among these dwarf-growing species of *Phlox*, which the hybridiser is but too apt to overlook in his hurry after more showy plants. The seeds of *Collomia* form beautiful microscopic objects, the outer coat being composed of spiral tissue, which uncoils in the most charming manner when a fragment is moistened on a slide. In the 'Proceedings of the American Academy' (1870), Prof. Asa Gray points out that "the two sorts of style which Professor Thurber and Professor Torrey have detected in the genus *Phlox* (namely, that more than half the species have a long style, so that the stigmas are often exserted, while the rest have very short ones, bearing the stigmas low down in the tube of the corolla), are somehow of dimorphic nature. Yet it is only in *P. subulata* that I have seen both long and short styles; and here the short-styled plant has (irrespective of this character) been described as a distinct species (*P. nivalis*, *P. Hentzii*), and is apt to have a pair of ovules in each cell, while the long-styled *P. subulata* rarely shows more than one. Moreover, in the *speciosa* group this character of the style really furnishes one of the most available specific distinctions. Whatever view be taken of it, the case may properly be compared with that of certain species of the generally dimorphic genus *Primula*, mentioned by Mr Scott (in 'Jour. Linn. Soc.,' viii. 80), which, so far as known, are either long-styled or short-styled without their complementary fellow. Similarly the two species of *Gilia* composing the group which I have named *Giliandra* might be regarded as the long-stamened form, of which the short-stamened counterpart is unknown or non-existent. A state of things which, although singular, is intelligible upon the doctrine of the gradual evolution of specific and dimorphic differences."

This last remark fully bears out my views, that wherever there are traces of dimorphism, or protogynous arrangements, there cross-breeding operations are easily carried on artifi-

cially; indeed it is questionable whether these natural arrangements for securing cross-fertilisation are not themselves the consequence of natural hybridism and selection.

THE BUCKWHEAT FAMILY (*Polygoniaceæ*).

Annuals, herbaceous plants, or rarely shrubs, distributed throughout Europe, Asia, Africa, and North America. They are also found in South America, the Levant, and one or two species in the most northern limits of vegetation. The principal genera found in our gardens are *Eriagonum*, *Rheum* (Rhubarb), *Polygonum*, *Fagopyrum*, *Coccoloba*, *Rumex* (Docks or Sorrels), *Antigonum*, and others. Many of the species are easily recognised by the coherent membranous stipules, which form an ochreate tube around the stem at the nodes. Nearly all the species produce fertile seeds in great profusion, and the hardy kinds may be sown as soon as ripe, or during the spring months, in a warm sheltered bed or border. Tender kinds should be sown in heat. They are represented by the medicinal and esculent Rhubarbs, Polygonums or Buckwheats, and Docks or Sorrels. The hardy Rhubarbs, both useful and ornamental, are readily increased during mild weather in winter by dividing the fleshy crowns and replanting where they are to remain. *R. Emodi* and the newly-introduced *R. nobile* from the Himalayas are very effective sub-tropical plants. The Docks are well-known native weeds. The Field-dock (*Rumex pratensis*, see 'Top. Bot.,' p. 343) is supposed to be a natural hybrid between *R. crispus* and *R. obtusifolius*. Several forms are known to occur on the Sheriffmuir Road, near Stirling, West Perth; and it would be interesting to know whether these hybrid plants reproduce themselves from seeds, or whether they are seedlings from one of the last-named species which becomes accidentally fertilised by pollen from the other.

THE PURSLANE FAMILY (*Portulacaceæ*).

A small order of succulent shrubs, or more generally herbs, represented in our gardens by *Portulaca*—showy crimson, purple, rose, white, or yellow-flowered plants, with a habit similar to the Fig Marigolds—*Anacampseros*, *Calandrinia*, *Claytonia*, and one or two others. They seed freely if planted in sandy soil and protected from too much damp at the root.

Portulacas seed rather late in the autumn, and the best plan is to pull up the plants before the autumn frosts appear, and lay them on a sunny shelf in the greenhouse or window, where they will keep fresh for a month or six weeks until the seeds become perfectly ripe. Cuttings of the perennial species root freely in dry sand or brick-dust if placed on an airy shelf in the greenhouse fully exposed to the sun.

THE PRIMROSE FAMILY (*Primulaceæ*).

This order of low-growing hardy or half-tender herbaceous or evergreen plants has furnished us with some of the most charming of all decorative plants, including the following genera, all beautiful, and nearly all of easy culture: *Anagallis, Dodecatheon, Primula, Cyclamen, Androsace, Cortusa, Soldanella,* and *Lysimachia.* This pretty group is distributed throughout Europe, America, North India, Japan, China, and one little-known genus (*Samolus*) is common in North Holland.

Anagallis (*Pimpernel*).—Annual or perennial hardy or half-hardy trailers, long grown in our gardens and very easily propagated, the annuals by seed and the perennials by herbaceous cuttings in the spring, or by seeds sown in a gentle heat ready for planting out in May or June. Some form very pretty basket-plants for conservatory or window culture. The species are—*A. platyphylla*, a large blue-flowered Algerian species, one of the most beautiful; *A. alternifolia* (yellow and pink), introduced in 1839 from Rio Janeiro; *A. carnea* (annual), Switzerland, 1819; *A. fruticosa* (orange-scarlet), Morocco, 1803; *A. indica* (blue), 1824; *A. Monelli* (blue), introduced from Italy in 1648, and of which there are several garden varieties, including *A. Brewerii, A. lilacina, A. Phœnicea, A. Phillipsii,* &c.; *A. Wellsiana* is a hybrid raised in 1830; *A. Marryattæ* is also of hybrid origin, said to have been raised in 1828. Dean Herbert (see 'Amaryllidaceæ,' p. 379) observes that in Anagallis he had seen a remarkable result, a distinct reddish-purple-flowered variety having been obtained by crossing orange and blue flowered kinds.

Flower of Pimpernel (Anagallis arvensis), enlarged.

Many seedling varieties of Anagallis used formerly to be grown as decorative plants. Twenty or thirty years ago, numerous forms were raised and advertised by florists under such names as *A. cærulea grandiflora*, *A. carnea grandiflora*, *A. speciosa*, *A. multiflora*, &c.; and these are still occasionally grown. It is curious to note that in all cases seedlings of exogenous plants do not always grow by the development of the terminal bud between the seed-leaves, but from lateral buds below the seed-leaves or cotyledons. A correspondent of the 'Gardeners' Chronicle,' 1871, p. 836, in speaking of buds being produced on the stem below the seed-leaves, says: "These are produced very quickly in the common Pimpernel—*Anagallis arvensis*. When the top of the young stem with the cotyledons is cut off, minute protuberances arise on the sides of what was before the smooth and naked stem, and from these issue buds with leaves."

Cyclamen (*Sowbread*).—A very beautiful genus of Primulaceous plants, natives of Europe and some parts of Asia, the best-known species (*C. persicum*) being a native of Lebanon. This plant has of late years been much improved by London

Cyclamen persicum

Cyclamen Atkinsii.

florists and market-growers, by whom it is largely grown as a market-plant; and the beautiful varieties are now innumerable, and of all shades of colour between snowy white and purplish crimson. *C. hederæfolium*, *C. Coum*, *C. europæum*, *C. vernum*,

C. neapolitanum, and others, are hardy, and grow and bloom well in sheltered positions on warm, dry soils. *C. Atkinsii* is a garden hybrid obtained by Mr Atkins of Paniswick some years ago. All the species and varieties are easily multiplied by seeds, which should be sown as soon as ripe in light sandy soil and placed on a gentle bottom-heat. If imported or one-year-old seeds are used for propagating purposes, sow them in a pan as early in October as possible, previously steeping them in moderately hot water, as they are unusually hard and slow in coming up. Put a pane of glass over the pan and place it near the glass in some warm spot. Germination will take place in about a fortnight, and the pane of glass must then be removed from the pan to prevent damping off and drawing.

"To have good plants of *C. persicum*," says Mr Little, "the seed should be sown in a temperature of 50°, and the young plants should be pricked off into forty-eight-sized pots, placing ten in each pot; and when big enough, they should be potted singly in small sixty-sized pots. When these are well filled with roots, they should be potted into forty-eight-sized pots, in which they will flower the following spring. After this shift they should be placed in a cool, sunless house, and well watered both at root and overhead. All stimulants, in the way of manure or guano-water, should be avoided, and nothing used except pure soft water, otherwise the flower-stalks become drawn and weak, and the strength of the plant is expended in the production of foliage."

Dodecatheon (*American Cowslip; Shooting-star*).—A small genus of pretty little herbaceous plants from North America, the leaves of which resemble those of *Primula*, while the reflexed segments of the flowers remind one of the same organs in the *Cyclamen*. The flowers are generally rosy purple, and are borne on umbellate trusses nearly a foot in height. Represented in our gardens by *D. integrifolium*, introduced in 1829, and *D. Meadia*, a much older inhabitant of our gardens and a more variable plant, introduced in 1744. Both species have light-purple flowers, but of the last-named there are three or four distinct varieties—as *albiflorum* (white), *elegans* (rosy), *giganteum* (lilac), and *lilacinum* (rosy lilac). They are all readily multiplied by dividing well-established roots in the autumn, or by seeds, which not unfrequently ripen on warm soils. The surest way of obtaining fertile seeds of good quality is to grow the plants in pots in a sunny frame where they are more immediately under the eye of the cultivator. The flowers should be thinned, only leaving five or six on a scape; and these should be carefully fertilised so as to insure a maxi-

mum supply of plump, sound seeds. Mr Anderson-Henry made some experiments in hybridising this genus with *Primula*, but failed to obtain satisfactory results, although fertile seeds were produced. Further trials might succeed. Hybrids might possibly be obtained between *Dodecatheon* and some species of *Cyclamen*, since they seem to be more nearly allied than any other genera in the order. The germination of *Dodecatheon* seeds is rather anomalous, and is thus described by a correspondent of the 'Gardeners' Chronicle,' 1871, p. 836: "In seedlings of *Dodecatheon Meadia*, I find that the cotyledons remain for a considerable time fully expanded, without the least trace of a bud showing itself in the axil; but at length a bud breaks forth through a longitudinal cleft in the apparent stem just above where the radicle enters the earth. In this case, which is quite different from that of the *Anagallis*, the stem which supports the cotyledons may be only their united prolonged bases in which the bud is immersed, as it is in some American Compositæ, which expand their cotyledons above the surface of the earth, supported upon an apparent stem, which is, however, tubular, and the bud really rises from a point below the surface of the ground and pushes its leaves up through the axil." This case of the *Dodecatheon* is additionally interesting when we remember that in *Cyclamen* the embryo is pushed out of the seed-coats, as a part of the germinative process, in a way analogous to what generally occurs in endogenous plants (see *Yucca*).

Primula.—This is one of the most attractive of all our groups of garden plants, partly from the ease with which they may be propagated and cultivated, and partly from the variability in the form, size, arrangement, and colour of their in many cases fragrant flowers. Our common native Primrose has long been cultivated in gardens, and from it and *P. veris*, the Cowslip, has originated the Oxlip Primrose, and numerous beautiful forms of richly-coloured Polyanthus or many-flowered Primroses, now so popular in our outdoor gardens and woodland walks. Parkinson (1629) describes and figures many varieties of double, single, and monstrous Primroses and Cowslips then cultivated in English gardens. The whole matter of cross-fertilisation between the Cowslip and common wild Primrose is full of interest; but it demands more space to explain than can here be spared. The reader, however, may refer to Darwin's papers on the subject in the 'Jour. Linn. Soc.,' x. 393-437. Primulas are distributed throughout nearly all temperate countries, many of the European species being Alpine. Some of our most beautiful Primroses come from

China and Japan, where they have long been cultivated and probably much improved. *P. sinensis* and *P. japonica* are especially well-known examples; and *P. cortusoides* (*P. Sieboldii*) is undoubtedly one of the finest of all Primroses, and its seedlings, like those of the last-named species, come of different colour and vigour. From the Himalayas we have yet to import some striking species. *P. sikkimmensis* and *P. Stuartii* are noble yellow-flowered kinds, which cover hundreds of acres at a considerable altitude on the Himalayan slopes, much as our Cowslips cover verdant hillsides here at home. For a full illustrated account of the garden Primroses, see the 'Garden,' ix. 101. Mr A. W. Bennet contributes the following note on hybrid Primulas to the 'Gardeners' Chronicle,' 1875, p. 813: "Professor Kerner of Innsbrück has reprinted from the Austrian 'Botanische Zeitschrift' a description of the hybrid *Primulaceæ* of the Alps, numbering thirty-one in all—twenty-five belonging to the genus Primula, four to Androsace, and two to Soldanella. Of the hybrid Primulas by far the majority (twenty) are included in the section Auriculastrum, the remaining five in that of Primulastrum, Schott. No intercrossing is known between these two sections. In the section Primulastrum all the hybrids belong to the sub-section Euprimula, Schott—*P. acaulis* (*vulgaris*, Linn.) showing the greatest sexual affinity for the others. In the section Auriculastrum, *P. Auricula* and *minima* are the species which show the greatest tendency to hybridise, although these two species cannot be made to fertilise one another. These hybrid Primulas are much more easily cultivated by the vegetative modes of reproduction than their parents, and usually exhibit a combination of the characters of their parent forms. Of 'derivation hybrids'—*i.e.*, crosses between a hybrid and one of its parent forms—the author only knows one or two instances. Of these hybrid Primulas not a few have been described as species: among the most interesting of which are *P. brevistylis*, D.C., between *acaulis* (*vulgaris*) and *officinalis* (*veris*); *P. pubescens*, Jacq., the ancestor of our garden 'Auriculas,' between *Auricula* and *hirsuta*; *P. alpina*, Schleischer (*P. rhætica*, Koch), between *Auricula* and *viscosa*; *P. Flörkeana*, Schrad., between *glutinosa* and *minima*; and *P. venusta*, Hort., between *Auricula* and *carniolica*." The late Dean Herbert raised a powdered *Auricula* and *Primula helvetica* from seeds of *P. nivalis*; and *P. helvetica* also from seeds of *P. viscosa*, and from these observations he concludes these Swiss Primulas to be local varieties of one species or type (see 'Trans. Hort. Soc.,' iv. 19).

It is curious to observe that nearly all the European forms

of Primula merge into each other, and seem to possess an aptitude for hybridising. *P. variabilis*, a French wilding found in the environs of Grenoble and Nancy, is supposed to be a natural hybrid between *P. officinalis* and *P. grandiflora* of Grenier and Godron. M. Lecoq succeeded in raising a white Polyanthus by crossing a pale Oxlip with a white form of *P.* (*acaulis*) *vulgaris*, but failed to cross the Auricula with the last-named species.

In the December number of the 'Revue des Sciences Naturelles,' 1875, is a short paper by D. A. Godron, on fertilisation of flowers by Hymenoptera. Near Nancy it is found that the hybrid Primula (*P. variabilis*) produced by the fertilisation of *Primula grandiflora* with pollen of *P. officinalis* results from the intervention of bees, but the converse hybrid does not occur. M. Godron published an account of this in 1844. The reason for the non-occurrence of the second hybrid is that *P. grandiflora* flowers earlier in this locality than *P. officinalis.* M. Godron was able to produce the hybrid *P. grandiflora-officinalis* artificially, but never saw it as a natural product till March 1874, when it was brought to him from a locality two kilometres distant from the first. On investigation it was found that only *P. officinalis* grew at this spot, and that owing to situation and surroundings it flowered much earlier than in the other locality; but the hybridisation could only be effected by the carrying of the pollen of *P. grandiflora* two kilometres by bees.

P. Auricula (*Auriculas*).—The Auricula is the only Alpine plant which has become popular as a florist's flower. Prof. Kerner (see 'Die Geschichte der Aurikel') has traced the history of this plant from the time of L'Ecluse (Clusius), who first transplanted *Primula Auricula*, and the natural hybrid *P. pubescens*, Jacq., from the Tyrolese Alps to Belgium in 1582. The latter plant, and not the true *P. Auricula*, L., is believed by Prof. Kerner to be the real ancestor of the cultivated Auricula. In the time of Clusius both plants were known as "Auricula Ursi I." and "Auricula Ursi II." or "Bear's Ears." The hybrid *P. pubescens*, which had been lost from the German and Austrian Alps for nearly three centuries, was found in a single locality in the Tyrol by Prof. Kerner in 1867. These favourite florists' flowers are propagated from offsets or by seed. The side-growths of any desirable variety root freely in the spring or summer, taken off and treated like cuttings in a close frame. These can be taken from the plants at any time when they are moving, as the florists say, or making growth. Some varieties will produce several offsets, and do not appear to be weakened by the process, while other varieties produce offsets very spar-

ingly indeed; and it is sometimes very difficult to get a stock of them in consequence. It is not at all necessary that offshoots be rooted before they are removed from the parent plant. So long as the set has a heel, it will soon throw out roots. New varieties can only be raised from seed, and only good sorts should be allowed to bear seed. Careful cross-fertilisation is the surest way of obtaining novelties, but seed saved indiscriminately from a frame of good varieties will yield a fair percentage of good sorts. Auricula seed requires careful treatment. It should be carefully gathered and wrapped in demi-paper, the name of the parent or parents being written on the packet, or a number may be placed on the packet, and the names, date of gathering, and other interesting particulars, entered on a page similarly numbered in a memorandum-book. Sow the seeds in January or February, on the surface of well-drained seed-pans, filled with light, rich, sandy soil, which has been made quite smooth. Distribute the dust-like seeds equally, and cover with just a sprinkling of fine light compost. Place the pans in a frame, on a very gentle bottom-heat, and keep the soil in that genial condition known as moist—that is, neither wet nor dry. In a month or five weeks the tender young plants make their appearance, and they should then be very gradually inured to more air and a drier atmosphere, in order to counteract any tendency towards "damping off." Remove them to a shady cool frame in April; and if they are in danger of becoming crowded, prick off the strongest seedlings and treat them like established plants. The Alpine varieties grow much quicker than the show kinds, and may be potted off into small pots towards the latter end of July. If bottom-heat is not employed, many of the young plants will not appear until the second year, but by adopting the above plan, many of the strongest plants will bloom in little over a year from the date of sowing the seed. Numerous varieties are being raised annually by such growers and exhibitors as Mr Charles Turner of Slough, Rev. H. H. Dombrain, Mr J. Douglas of Loxford Hall, Ilford, and the Scotch and Lancashire growers, for nearly all Auricula-fanciers make a point of raising seedlings. The Rev. F. D. Horner has obtained a very distinct strain of show Auriculas by crossing a grey-edged variety named "Charles Brown" with pollen from a similar variety named "George Levick." Some of these seedlings are yellow selfs; others have the ground or body colour yellow, with the addition of a pale-green edge. They are so pretty and distinct, that there is every promise of a new race of fancy Auriculas being obtained from them. They were first exhibited at Manchester

in 1876. M. Lecoq is of opinion that the Auricula, which he describes as the most beautiful of the genus Primula, has been derived from the intercrossing of several European species with seminal varieties of the Alpine Primula *P. Auricula*. Among those species most likely to have been used in the production of this now lovely florist flower, he cites *P. marginata*, *P. viscosa*, perhaps *P. villosa*, *P. hirsuta*, and *P. integrifolia*. I fully endorse M. Lecoq's opinion: and no one who has seen the above-named species growing in the same frame with Auriculas would doubt that they were intimately related; and this is especially manifest in the case of *P. marginata*, which evidently lends its mealy-margined serrate foliage, sub-shrubby habit of growth, and sub-erect flowers, to many of our finest Auriculas of to-day. Gaertner observes that the two sections represented by *P. vulgaris* and *P. Auricula* cannot be made to intermix, as, from their different habit, substance, and structure, might be supposed to be the case. Both sections exhibit the pin-eyed (long style and short stamens) and thrum-eyed (short style and long stamens) structure so ably alluded to by Darwin in a paper contributed to the 'Linnæan Society' (x. 393 and 437); and cultivators who wish to raise seedlings should bear in mind the fact, that the interbreeding of a pin-eyed and thrum-eyed variety gives the largest proportion of fertile seeds.

P. viscosa var. *intermedia* is a garden hybrid between *P. Auricula* and *P. viscosa*. The parentage of the Auricula is readily distinguished by the larger and smoother leaves, and the deep purple colour, with a well-defined white eye. Several other hybrids from the same source are now in cultivation, varying in colour, and notably distinguished from the Auricula by the denser character of the plant.

The seeds of *Primula sinensis* (see 'Bot. Mag.,' t. 2564) may be sown in succession from February to June, so as to have a longer supply of flowering plants. Sow the seeds on the surface of a well-drained pan of light leaf-mould and sand. Do not cover it with soil, but place a pane of glass painted green over it, and set it in a case or stove, and if possible on a genial bottom-heat of 55° to 65°. The seed germinates in two or three weeks, after which the glass should be removed, and the pan placed in a warm position near the glass, but shaded from bright sunshine. The seeds of all the rare Indian or Chinese species may be raised in the same way, and gradually harden them off after germination has taken place, and the young plants have acquired some strength. Hardy Primula or Polyanthus seeds may either be sown as soon as ripe, in pans or boxes of light sandy soil, and placed in a cold pit or frame, or

sown on raised nursery beds in the spring in the open air (see Auricula). Desirable seminal varieties or hybrids are only to be multiplied by careful division, or by taking off the lateral side-growths as cuttings. There is a wide field in this genus for the intelligent hybridist, seeing that all the beautiful Indian, Chinese, and Japanese species are quite as amenable to cultural skill as our native species, such as *C.* (*acaulis*) *vulgaris*, *C. veris*, and *C. elatior*, whence the lovely crimson, purple, maroon, golden, rose, lilac, and yellow varieties, not forgetting the gold-laced forms and double varieties, have originated. How or when the change was brought about we do not know with any degree of certainty; but Parkinson (1629) and other ancient florists speak admiringly and describe numerous forms of Polyanthus and Auriculas, or "Bear's Ears," as they were popularly termed by the older florists. Among the species suited for hybridising are *P. japonica*, *P.* (*Sieboldii*) *cortusoides* and its varieties, *P. Parryi*, *P. sinensis*, *P. verticillata*, *P. pulcherrima* (Backhouse), *P. sikkimmensis*, and many other of the finer oriental species and forms.

Mr J. Anderson-Henry has attempted the hybridisation of several species of Primula; but he was singularly unfortunate, scarcely a single perfect seed having been obtained. Col. Trevor Clarke, another skilful and intelligent hybridist, has also made experiments with this genus, the results of which were not encouraging. Some of the Indian species—such as *P. sikkimmensis*, *P. Stuartii*, and others—seed very freely in their native habitats: indeed, nearly all the species produce a copious supply of fertile seeds; and several white, lilac, and rosy varieties of *P. japonica*, *P. cortusoides*, and *P. sinensis* have been raised in our gardens. It would be interesting to attempt the hybridisation of the whorl-flowered species, such as *P. verticillata*, *P. japonica*, and *P. sinensis*, which shows an inclination to become whorled in some of its forms: or is the plant a hybrid obtained by the Chinese gardeners?

Primula intermedia is a garden hybrid with the habit of an Auricula. It is the result of a cross effected between *P. ciliata* and *P. minima* (see 'L'Illustration Horticole,' t. 482).

Primroses of the *P. vulgaris* section have been much improved of late years by Mr R. Dean of Ealing, who set to work with *P. vulgaris auriculæflora*, a beautiful old variety of a rich maroon-crimson colour; and from seedlings of this variety crossed with each other, such forms as Rosy Morn, Violet Gem, Violacea, Splendour, and others, have been produced, and are characterised by large, rich, smooth-petalled flowers, having a bright golden centre.

THE PROTEAN FAMILY (*Proteaceæ*).

A highly variable group of evergreen shrubs or small trees, principally natives of the Cape and New Holland, while a few are found in South America and other places in the southern hemisphere. They are represented in our gardens by the following genera: *Leucadendron* (Silver-tree), *Protea*, *Grevillea*, *Hakea*, *Rhopala*, *Lomatia*, *Banksia*, and *Dryandra*. Nearly all the species are best propagated by imported seeds, if these can be procured, and in many cases root-cuttings in a gentle bottom-heat are successful. Seeds are rarely produced in cultivation, but this is doubtless in many cases owing to the absence of the necessary insects to fertilise the flowers. If a flower of almost any Protead be examined, the form and arrangement or partial confinement of the peculiar style seems especially formed to secure cross-fertilisation. Any species of *Grevillea* will illustrate what is here meant. M. Viviand-Morel, of the Lyons Botanic Garden, has succeeded in cleft-grafting many species of *Grevillea*, including *G. Manglesii*, *G. Trobei*, *G. longifolia*, *G. Bauerii*, and others, on seedlings of the common *G. robusta* as a stock. The operation should be performed in heat under a *cloche* or close case in the propagating-house, the early spring months being the best time (see 'Revue Hort.,' 1868, p. 49). The rare and beautiful *Embothrium coccineum* from Lima may be propagated by root-cuttings, or by grafting cuttings on thick bits of its own roots.

THE ROSE, POME, AND DRUPE FAMILY (*Rosaceæ*).

This order contains species among which may be found some of the most useful as well as the most beautiful of all plants. The Rose itself has long been styled the "Queen of Flowers;" and while artists have vainly attempted to paint her blushes, poets have rivalled each other in singing her praises. In this sternly practical age, however, the rosaceous fruit-trees receive perhaps the most attention in our gardens—attention which they richly deserve. To these belong the Apple, Pear, Quince, Medlar, and other pomaceous or Pome-like fruits; while in the Drupe-bearing section (stone-fruits) we have Plums, Peaches, Nectarines, Almonds, Cherries, and Apricots; another section being represented by the berried fruits, Strawberries, Raspberries, and Blackberries (some fine cultivated forms of which exist in American gardens). Among the most con-

spicuous of rosaceous flowering plants may be mentioned shrubby and herbaceous Spiræas, double-blossomed Plums, Cherries, Peaches, Almonds, &c., rosy-white and scarlet Japanese Pyrus, scarlet-fruited or flowering Hawthorns (*Cratægus*), orange-berried Pyracantha, Cotoneaster, and Pernettyas, and some very attractive single and double flowered forms of Rubus, Medlars, and Amelanchiers.—(See Hogg's 'Fruit Manual' (4th ed.), 1875, for interesting historical and other details of rosaceous fruits, &c.)

Amygdalus.—A well-known and useful genus of Roseworts, containing the Peach, Nectarine, and Almond. According to some authors, Morocco and Barbary are the native countries of the Almond; while the Peach is generally supposed to be Persian, although M. de Candolle, in his 'Géographie Botanique,' assumes China to be the country whence this fruit originated, but the fact of these plants having been cultivated for ages renders it extremely difficult to trace their original habitats. The Almond resembles the Peach in habit, but has a leathery coat to its fruit, the stone or kernel being the part eaten. The Peach has a soft fleshy covering to the stone; and the object here sought after by the cultivator is to produce large and prolific varieties, with succulent delicately-flavoured pulp and small stones. The Nectarine is a variety of Peach, having a smooth skin. The near relationship of Peaches, Nectarines, and Almonds is well known to horticulturists, who employ the Almond as a stock for cultivated varieties. Nectarines have also been borne on the same branch along with Peaches, and Mr Knight proved that they would interbreed readily. He crossed an Almond flower with pollen from a Peach, and an Almond fruit was produced, from the stone of which he raised a tree which bore Peaches better than some seedlings raised from Peach-stones. Mr Rivers has also raised some valuable varieties of Nectarines from Peach-stones, and *vice versâ*. A list of seedling varieties of modern date, with their parentage when known, is here given. Careful cross-fertilisation between two good varieties is the surest way of obtaining new forms; but if a large quantity of stones is planted, new forms of merit are not unfrequently produced without artificial fertilisation. Mr Rivers is of opinion that the Noblesse and some others of our best Peaches originated from the old White Nectarine. That comparatively new and fine Peach Prince of Wales was raised by Mr Rivers from a stone of the Pitmaston Orange Nectarine; while of ten seedlings raised by him from stones of this same Peach Prince of Wales, five turned out to be Peaches and five Nectarines—three of the latter being orange and two white

fleshed. Peaches and Nectarines are propagated by either budding or grafting.

Stocks.—There are a variety of these upon which the Peach succeeds with more or less success; the best, however. being the hard-shelled Sweet Almond, Damson Plum, Muscle and Pear Plum, all of which can easily be raised from seed or layers. Some use the Myrobalan; but it is not sufficiently permanent, and the trees do not succeed well after the first few years. The Almond stock is hardy and a robust grower, and succeeds well on some warm dry soils. Seedling Peaches do not form good permanent stocks in this country, although much used in America. Double grafting or budding is often practised with success. It is a little curious to notice the great difference of opinion which exists in different nurseries as to the best stocks for nearly all fruit-trees; and it is now well known that different stocks are each best suited to different soils. The question of stocks on which to work our finest varieties of hardy or tender fruits is such an important one, that we should like to see collections of all known plants used for fruit-tree stocks got together and tried side by side in different soils and situations. A series of experiments thus intelligently conducted would clear up many doubts and throw much additional light on this interesting subject, which is one of the utmost practical importance to the professional gardener and fruit-grower for market. What are known as French Peaches, such as Bourdine, Double Montagne, Belle Chevreuse, and others, will only succeed on the Pear Plum as a stock. Other varieties prefer the Muscle Plum, while the Brompton stock suits nearly all varieties equally well; but the trees on this last, although at first vigorous and healthy, are invariably short-lived, according to Lindley, who also remarks that the Lemon is a better stock for the Orange than its own varieties, and it is now well known that *Citrus japonica*, or Kumquat Orange of Chinese and Japanese gardens, will not fruit in cultivation unless grafted on *Limonia trifoliata* as a stock. In the 'Trans. Hort. Soc.', v. 289, Mr T. A. Knight records a curious fact, showing the influence of the stock on the size, colour, and flavour of the Peach "Acton Scott," one of which was growing on a seedling Peach or free stock, and the other on a Plum stock. That growing on the Plum bore larger and more highly-coloured fruits; but its flesh was so coarse and inferior, that he would have denied the identity of the variety had he not budded both the stocks himself from the same tree. Facts like these are useless, however, unless the cultivator takes advantage of them to observe carefully on what stocks his

trees are worked, and the advantages and disadvantages of each on different soils and in different situations. Our fruit nurserymen, too, should work out this subject, since in the long-run such a course would conduce to their own advantage; instead of which it is often plainly to be seen that the subject is studied from one point only—those stocks which succeed best in their own soil and locality being adopted, to the exclusion of others which are equally as well adapted for other situations and soils. This may be called plain speaking; but it is necessary here to speak plainly, in order to avoid being misunderstood.

Budding.—This may be performed in April, just as the bud is breaking, or in July and August, with a dormant double or triple bud. Select buds (or grafts) from medium-sized foreright shoots, and if the operation is to be performed early, the buds may be hastened in their development by pinching the end of the growing shoot. Almond or Plum stocks may be sown as soon as gathered in autumn, and budded the autumn following, or when about a year old. Prepare the stocks a week or two before budding, by clearing off all the lateral branches. Insert the buds in the usual way, or by shield-budding, on the north side of the shoot or stock. Some graft the Brompton stock on the seedling Almond as an intermediary, and crown-whip or splice-graft with the desired variety in April. It is a noticeable fact at Montrieul, near Paris, that Peaches of the same variety, grown under otherwise equal conditions, are a week or ten days earlier on the Plum stock than when grafted on the Almond; hence the Plum stock should be used for the early varieties in preference to any other. Some bud the Brompton, Muscle, or Pear Plum on seedling Peach stocks, and crown or cleft-graft these with scions from the desired variety the second year. Ornamental double-flowered Peaches or Almonds may be either budded or grafted on any of the above stocks. Grafting may either be performed in the nursery rows in the open air, or stocks may be potted and worked under glass. In the case of the ornamental varieties, this is quickest and best. In an emergency any seedling Plums may be used as stocks for Peaches and Nectarines, as well as for choice varieties of their own species. It would be interesting to know whether the Plum, Peach, Nectarine, or Apricot will hybridise with each other; and this experiment may be tried, even if it leads to no practical good.

Peaches raised from Seed by Mr Rivers and others.

Alexandra Noblesse.—Very large. This fine Peach is named in Dr Hogg's 'Fruit Manual', simply the Alexandra. It is, however, a true Noblesse in its fruit, and was raised from that sort; its habit is different, as it has smooth leaves and round glands; hence it is not liable to mildew; flesh melting, rich, and excellent; flowers large; tree very hardy.

Comet.—Large, nearly round; orange, with a crimson cheek; melting, sweet, and good; ripens early in October, a week or so before its parent the Salway peach; flowers small; glands kidney-shaped.

Crimson Galande.—Medium size, often large; deep crimson; flesh tender, melting, rich, and deliciously flavoured; a freestone Peach of the most hardy, prolific, and vigorous habit: middle to end of August. Flowers small.

Dagmar.—Large; melting and rich; skin very downy and of a deep crimson; very handsome; ripe early in August. This is a seedling from the Early Albert Peach; glands round; flowers small.

Dr Hogg.—Large; firm, yet melting; often stained with red under the skin; flavour rich and sugary; a freestone Peach; hardy, vigorous, and most prolific: middle of August. Flowers large.

Early Alfred.—Above medium size; melting, and peculiarly rich and agreeable; a most delicious freestone Peach, raised from Hunt's Tawny Nectarine: early in August. Flowers large.

Early Beatrice.—Medium size, with a marbled red cheek; flesh melting, and very juicy; flowers large; glands small, kidney-shaped. This remarkably early Peach was raised from a stone of Rivers's White Nectarine, and is the earliest sort known, ripening 1865, July 11, and in 1867-68, July 5, nearly a month before the Early York Peach in the same house.

Early Leopold.—Medium size; pale yellow and red; very rich and excellent; glands kidney-shaped; flowers small. Succeeds Early Rivers.

Early Louise.—Medium size; bright red, melting, very juicy and excellent. This is nearly as early as Early Beatrice, and is a seedling raised from the Early Albert Peach: glands kidney-shaped or nearly so; flowers small: ripens from July 12 to 16.

Early Rivers.—Large; colour pale straw, with a delicate pink cheek; flesh melting, or rather dissolving, with a rich

racy flavour most remarkable. It was raised from the Early Silver Peach, and is a grandchild of the White Nectarine: flowers large; glands kidney-shaped. It ripens from July 14 to July 18; in 1864, the first season it fruited, it ripened July 18, and since then from the 14th. This sort, with Early Beatrice and Louise, will be found very valuable for forcing, as they will ripen early in June with very slight forcing. This Peach is apt to crack at the stone; the fruit then ceases to swell and has no flavour. To obviate this fault, it should be fertilised with the pollen of other flowers. It is possible that the immaturity arises from insufficient impregnation.

Early Silver.—Very large; melting and rich, with the vinous flavour of the White Nectarine, its parent. Requires a warm position and climate: early in August. Flowers large.

Lady Palmerston.—Large; melting and very good; skin greenish yellow, marbled with crimson; very handsome; flesh pale yellow. It was raised from a stone of the Pine-apple Nectarine, and partakes of its flavour. This fine Peach ripens towards the end of September, and is a most distinct variety: flowers small; glands small and kidney-shaped, or nearly so.

Large Early Mignonne.—Very large; pale straw, with a rosy cheek. This very fine Peach was raised from the Belle Beauce; it ripens a week earlier than the Early Grosse Mignonne, and is melting and very rich: flowers large; glands round.

Lord Palmerston.—Very large, the largest of Peaches; skin creamy white, with a pink cheek; flesh firm, yet melting, very juicy and rich. It was raised from the Princess of Wales Peach, and resembles in its size and beauty its grand-parent the monstrous Pavie of Pompone; flowers very large and beautiful; glands nearly round: season from middle to end of September. It clings slightly to the stone unless fully ripe.

Magdala.—This fine Peach has been raised here from a stone of Rivers's Orange Nectarine. Size medium, shape inclined to oval, skin nearly smooth like a Nectarine; colour creamy white, marbled and blotched with crimson; flavour a combination of the Peach and Nectarine; quite original and exquisite. Season middle to end of August: glands kidney-shaped; flowers small.

Princess of Wales.—Very large; one of the largest and best Peaches known, and one of the most beautiful; its colour cream, with a rosy cheek; melting, rich, and excellent; ripens just before Desse Tardive, and is very valuable; flowers very large and beautiful; glands round.

Rivers's Early York.—Medium size; skin marbled with red;

flesh so melting and juicy as to dissolve in the mouth, leaving no fibre; its flavour has a smack of the Stanwick Nectarine, is original and perfectly delicious; leaves smooth with round glands, so that it is not liable to mildew like its parent the Early York; flowers large; season early in August.

Stanwick Early York.—Medium size; greenish yellow, with a red cheek; rich, with a distinct Stanwick flavour; leaves serrate; flowers large.

The Nectarine Peach.—Very large; pointed, with a smooth Nectarine-like skin; flesh melting, rich, and racy. It was raised from a stone of a Dutch Nectarine ('Le Grand Noir'), and has a peculiar delicious flavour; season the middle of September: glands small, kidney-shaped; flowers large.

Albatross.—A fine Peach of more than average size, raised from "Princess of Wales;" rich, juicy flavour: end of September.

Condor.—A large variety raised from a stone of "Early Silver;" skin of a glowing crimson; good flavour: August and September.

Early Victoria.—This resembles "Early York," but is hardier, and succeeds in cold situations.

Falcon.—A large seedling from the white Nectarine, pale in colour, but having a brisk flavour: August.

Golden Eagle.—This was raised from a stone of a late variety, which in its turn had been raised from "Crawford's Late," a well-known American variety; very large, 2-3 inches in diameter: October.

Goshawk.—A large-fruited late Peach, raised from a stone of "Cooledger's Favourite," an American variety. The skin is pale, but the flavour is very superior. August or September.

Merlin.—A large and luscious pale-coloured seedling, from "Early Grosse Mignonne;" rich flavour: August.

Osprey.—A large Peach, raised from "Pavie de Pompone," and sister to "Princess of Wales," but 8-10 days earlier.

Radclyffe.—A large seedling from "Desse Tardive," pale in colour, but of really good flavour: September and October.

Sea Eagle.—A large Peach, raised from a stone of "Early Silver." It is of pale colour and high flavour. End of September.

Knight's Markley Admirable.—This excellent variety was raised by G. Darby, Esq., Markley, Sussex, and is a freestone of the Teton de Venus type, of good size, slightly oval in shape, with a prominent nipple on the apex. It was grown in a cold house, and the fruit possessed a particularly rich flavour, so much superior to that of other early Peaches, that a first-

class certificate was awarded to it by the Royal Horticultural Society's Fruit Committee.

Early Ascot.—This is a good early variety, and was raised in 1866 by Mr J. Standish from a stone of the Elruge Nectarine, the flower having been fertilised with pollen taken either from Noblesse or Barrington. It has small flowers and roundish-reniform glands.

Walburton Admirable.—One of the best of all late kinds; was raised by the late Mr Morton of Walburton, Sussex, from a stone of Noblesse, a variety which it somewhat resembles.

Belle de St Geslin.—This is a very late Peach, ripening in the end of October or beginning of November. It is a chance seedling which was discovered by M. Joutron among the ruins of St Geslin, at Richelieu (Mare-et-Soire). Being a fortnight later than the Salway, it is valuable as a late Peach; and seedlings from this variety might possibly ripen on standard trees in cold orchard-houses still later in the year. Sent out by M. Defains of Amboise (see 'Revue Hort.,' 1873, p. 230).

Nectarines raised from Seed by Mr Rivers and others.

Albert.—Very large, round, remarkable for its brisk, vinous flavour, with a smack of the Stanwick; requires a warm site; one of the best forcing Nectarines.

Albert Victor.—Size monstrous; colour green, with a dull red cheek; flesh melting and good; season from the first to the second week in September.

Improved Downton.—Larger, but, like its parent, with a slight Stanwick flavour; one of the finest of Nectarines, raised from the Downton Nectarine.

Large Elruge.—Very large, melting, rich, and very good; a week later than its parent the Elruge.

Lord Napier.—This new kind, raised here from a stone of the Early Albert Peach, is the earliest good Nectarine known, ripening the first week in August; size medium; colour pale cream, with a red cheek; flesh melting, and parting from the stone; flowers large, glands kidney-shaped.

Pine-Apple.—Large, nearly oval, pointed; colour deep orange and crimson, very rich; ripens from a week to ten days later than Pitmaston Orange: the richest of all Nectarines.

Rivers's Orange.—Large, melting, with the rich saccharine flavour of its parent, the Pitmaston Orange. It ripens about a week earlier.

Stanwick Elruge.—Large, melting, and rich, with the Stanwick flavour; a few days earlier than its parent, the Elruge.

Victoria.—Very large; roundish oval, flattened at the top; greenish yellow, crimson on the sunny side; very rich and sugary, with the flavour of the Stanwick. The finest of all, but requires a warm climate or gentle forcing.

White (Rivers's).—Large; melting, juicy, and vinous; requires a warm dry soil; well adapted for pot-culture under glass, or forcing. It is earlier than the New White.

Byron.—A late yellow variety from late melting Nectarine. September.

Dante.—Large; rather later than the last; origin unknown.

Darwin.—An orange-coloured variety from "Rivers's Orange" crossed with Stanwick.

Humboldt.—A large variety from Pine-apple.

Advance.—The earliest of all the green-fleshed varieties, the fruit being of average size and having a rich Stanwick flavour. It ripens a fortnight before Lord Napier, and promises to be one of the best of all the early Nectarines.

Welbeck.—Seedling Nectarine, was raised at Welbeck by Mr W. Tillery, and is the result of a cross between Elruge (which it closely resembles) and the Balgowan (see 'Florist,' 1875, p. 13).

Cerasus (*Cherries*).—A genus of European shrubs or small trees, partly evergreen, as the common Laurel (*C. Lauro-cerasus*) and the Portugal Laurel (*C. lusitanica*), and partly deciduous, as in the case of our native Cherries or Geans. It does not appear to be generally known that two species of wild Cherry are found in Britain,—viz., *C. avium*, from which the races of improved garden varieties known as Bigarreau and Black-heart Cherries have originated; and *C. vulgaris* from which the small-leaved garden Cherries known as Kentish, May Dukes, and Morellos have sprung. Even in a wild state the fruit of these species varies greatly in size and flavour, some wild Geans being but little inferior to cultivated varieties. The Hertfordshire Couronne, or Crown Cherry, is an example, and this variety comes tolerably true from seed. The varieties of *C. avium* have been much improved in this country, Mr Thos. Andrew Knight having been one of the first to raise seminal varieties in an intelligent manner; and the variety known as "Black Eagle" raised by him, together with Knight's Elton and Early Black, are still first-class and standard kinds. It is singular to observe that when the seedling "Black Eagle" fruited for the first time in Mr Knight's garden, the fruit was flavourless and bad, and the Fruit Committee of the Horticultural Society condemned it as worthless. The tree was saved from being beheaded and used as a stock, however, through

the intercession of one of Mr Knight's children, who had planted the stone from which it sprang, and so one of our finest Cherries was preserved to our gardens. This confirms what is now known to be a fact—viz., that the value of seedling varieties of fruit cannot be judged until the trees have been grown and fruited several seasons. Numerous seminal varieties of this delicious fruit have been raised in France, Germany, Russia, and America, and the nationality of the varieties is in many cases denoted by their names. The Cherry season now lasts from May to August. It is a little singular to note that Mr Knight could never make the Morello breed with the Kentish or Duke race, notwithstanding that they are supposed to have originated from *C. vulgaris*. The Morello is the latest of all Cherries, and hangs well on the tree, but is not fit for dessert: its flavour would doubtless be improved, and a valuable race of late varieties be the result of fertilising it with the Late Duke or other excellent-flavoured varieties.

Mr Rivers has raised some seedling varieties from the "Early Purple Guigne," which are equally precocious and fine in flavour, besides being hardy enough to succeed well on open walls. About 100 of the best varieties are grown at Sawbridgeworth, and the more choice and tender varieties of the Guigne and Bigarreau race are double-grafted on the Mahaleb stock (*Cerasus mahaleb*), the intermediary or go-between portion of the stock being some vigorous kind of Duke or Morello Cherry worked on the Mahaleb by budding. The Mahaleb is the best stock for all the Duke, Kentish, and Morello Cherries, as the trees grow better and are longer-lived than when worked on the common Cherry or Gean stocks. Cherries are for the most part budded in our nurseries either on the small Black Cherry or Mahaleb stocks.

Cerasus mahaleb is a small-growing tree 12-16 feet in height, bearing a dense head of drooping branches on a slender trunk. It forms straight clean shoots of a greyish colour, often warted. The deep green leaves resemble those of the Pear in shape and colour, being about 2 inches long by 1¾ inch in breadth, bearing one or more round glands on the petiole. A good specimen may be seen about a hundred yards to the west of the Albert Memorial, Kensington Gardens.

M. Baltet recommends the red-fruited wild Cherry as being better for shield-budding than the black-fruited kind. Graft as a standard (not close to the ground) when the sap is on the decline. Cleft-grafting succeeds best towards the end of summer before the sap disappears. Grafting on the wild Cherry

succeeds best in June, and the stocks should be planted on the margins of walks or other open airy situations. In Belgian nurseries it is bud-grafted with a bud just commencing to grow, crown-grafted, or side-grafted with a simple branch. Scions or grafts should be moderately hard at the base—half woody, in fact—and these after being inserted should be shaded with a brown-paper cap. The Mahaleb (or St Lucie Cherry) is well adapted for dry soils, and should be budded near the ground. There are both weeping and variegated forms of the Mahaleb, and these should be grafted or budded on the common green form as a stock at any desired height. Black Cherry, Red Cherry, and other stocks are raised from seed (stones) or by "hillock layering." Suckers should not be used if seedlings can be had. A very distinct and hardy variety of the Morello, known as the "Dyehouse Cherry," is grown in America, and is said to fruit when other kinds fail through spring frosts (see 'Garden,' 1872, p. 321). The double-blossomed Cherry, one of our finest spring-flowering ornamental trees, is a form of *C. vulgaris*, and does well grafted on any of the common Cherry stocks. The Cherry grows and fruits well grafted or budded on the common Laurel, but this stock possesses no advantage over the common Gean or wild Black Cherry stock except in being more common; still it is always as well to know on what stocks a tree will grow, as it may serve when others are not to hand. This is one of the very few instances known where a deciduous scion has succeeded on an evergreen stock.

The Chinese double-flowering Cherry (*C. serrulata*) forms a tree 6-8 feet high, flowering in April, its flowers being larger than those of the common kind. Easily propagated by budding or grafting on seedling Cherry stocks.

C. Lannesiana is an ornamental tree of the highest merit, combining, when in flower, the effect of the delicate tinge of rosy Apple-blossoms with the freer grace of the longer and slenderer shoots and the brighter foliage of the Cherry-tree. The best mode of propagating it is by grafting it on the wild Cherry, either by cleft-grafting or by budding. M. Carrière, to whom we are indebted for the foregoing account, considers it probable that this is the type of *Cerasus Sieboldti.*

Seedling Cherries.

Early Rivers.—This is an excellent variety, bearing large black fruits, which ripen very early. It was raised by Mr Rivers from a stone of the "Early Purple Guigne;" and

while being as prolific and tender-fleshed as its parent, it is much hardier in constitution.

Early Amber Heart.—This is another of Mr Rivers's seedlings, raised some years ago, and is an excellent fruit and very early.

With the exception of Mr Knight's seedlings above mentioned, these appear to be the only Cherries raised in this country within the last thirty or forty years, most of the new kinds having been imported from Continental nurseries. For a detailed report on Mr Knight's seedlings and other Cherries—in all, fifty-seven varieties—see 'Trans. Hort. Soc.,' 1835, p. 248.

Amelanchier.—A genus of hardy ornamental North American and European trees, represented in our gardens by *A. vulgaris* and one or two others. The last-named species forms a low slender-branched tree, and bears a profusion of snow-white flowers in April. Propagated by layering or by grafting on the Quince, Hawthorn, or Pear as a stock. *A. vulgaris* is well worth a trial as a Pear stock, especially for delicate seedling varieties.

Cotoneaster.—A small group of low deciduous or evergreen trees or trailing shrubs, natives of Europe and the mountains of north India. There are ten or twelve species, those best known in our gardens being *C. microphylla*, *C. frigida*, *C. Simonsii*, and *C. buxifolia.* They are principally valuable for their bright red fruits, which, being borne very profusely, render these shrubs very ornamental among other evergreens during the winter months. They are all readily propagated either by layering in the autumn or from seeds, which are freely produced, and germinate as readily as haws. Some nurserymen bury the berries in sand all the winter, and sow them in shallow trenches in the spring, just like Holly-berries or other fleshy fruits. It does not appear to be generally known that these plants grow luxuriantly when grafted on the common Hawthorn as a stock; or if dwarf bushes or plants for covering walls are desired, then graft close to the ground on the Quince stock. *C. Simonsii* forms a very handsome standard on the *Cratægus* stock; and worked low on the Quince it forms dwarf bushy little specimens, which, grown in pots, are very handsome for conservatory decoration.

Cratægus (*Hawthorns*).—A genus of highly ornamental flowering-trees, represented in Britain by several forms of the common Hawthorn, which, apart from its beauty in the spring, forms one of our most useful hedge plants. Many other handsome Thorns are natives of Europe, North America, and other temperate countries; and some of these form very beautiful

ornaments to the lawn or shrubbery in autumn, when laden with their large golden-yellow or scarlet fruits. The Hawthorns are nearly related to the Medlars, for which the common May-tree, *C. oxycantha*, forms a good stock, although some nurserymen prefer the Pear stock. Some sorts of Pear, and especially Josephine de Malines and Jargonelle, grow well grafted on this stock; and I am informed that a Moorfowl-egg Pear-tree worked on the Hawthorn exists in full health and bearing in a garden near Edinburgh, notwithstanding that the specimen is known to be upwards of a century old. The Hawthorn will grow on any soil, and our hedges might be made profitable as well as useful by grafting them with Pears and Medlars; while if ornament is desired rather than eatable fruits, then the scarlet-berried Cotoneasters, the Mountain-ash, and the White Beam-tree may be grafted instead.

The fragrant Hawthorn is one of the commonest types of this genus, and, together with its rosy, crimson, pink, and double-flowered forms, is one of the handsomest small trees grown in our gardens, parks, and hedgerows. The "Evergreen Thorn," *Pyracantha japonica*, is one of the handsomest of all the scarlet-berry-bearing plants for wall or shrubbery decoration, and its varieties "*crenulata*" and "*fructi albo*" ought to be more generally cultivated along with the type. *Cratægus coccinea* is a variable but handsome European and North American species; and all the large-fruited kinds from North America, China, Japan, and north Europe well deserve a place in our gardens, as also do the cut-leaved, spiral, or fastigiate varieties of our native Hawthorn, *C. oxycantha*. Nearly all the species are readily propagated from seeds, which should be buried in sand or dry earth through the winter, and sown in shallow trenches in the spring following. Some, however, leave them buried until the second year. Layering is sometimes resorted to, but all the finest kinds are readily multiplied by grafting in the spring on common seedling Hawthorn stocks, or for low bushes the Quince may be used. Budding succeeds in July, and cleft-grafting in March or April. Seedling Pear stocks might be used for standards, especially in the case of strong-growing deciduous kinds.

Cydonia (*Quinces*).—A genus of ornamental and fruit-bearing shrubs or small trees, rarely more than 20 feet in height, and represented in our gardens by the common Quince (*C. vulgaris*) and its varieties. The Quince was much grown in the middle ages, being considered the most useful fruit of all. It not only formed the basis of the celebrated preserve called Cotig-

nac, for which the city of Orleans was so renowned, but it was also used as an accompaniment to most kinds of meat dishes. The Quinces of Portugal were considered the best; but the Cotignac of Orleans was so highly esteemed that it was never absent from the dinner-tables of the French nobility, and some boxes of this preserve were the first offering presented by the inhabitants of Orleans to Joan of Arc when, after succeeding in raising the siege, she entered that city on the 29th of April 1429. *C. japonica*, a scarlet-flowered and very ornate Japanese plant, bears small apple-like fruit, with a strong perfume. *C. Maulei* is nearly related to the last, and is also a native of Japan, its fruit being edible, and, like the common Quince, useful for marmalade. The Angers Quince and other varieties are readily propagated by cuttings of the young wood planted in autumn on the north side of a wall or fence. Layers root freely, hillock-layering from headed-down trees being best. Seeds should be sown as soon as ripe in rows in the nursery-beds, or the fruit may be buried in sand, and the sand and fruit mixed up together in the spring, and sown in shallow trenches two or three inches in depth. The Common Quince and its forms is found distributed throughout N. and S. Europe, Asia, and in the north of Africa. It is plentiful in Italy, and the Angers and Portugal varieties are more highly esteemed than any of the others by most of the Continental nurserymen, who use them as stocks for Pears. There are also forms bearing Apple and Pear shaped fruits, and experiments might be made with all these, as probably one kind may suit some varieties of the finer Pears better than another, and all three may be found to possess particular merits. Rea's Mammoth, a sub-variety of the Orange Quince, is in America highly recommended as being much larger than the common, and more productive. The fruit is tender throughout, like an Apple, and free from the hardness and harshness of the Pear Quince. Those who have grown Rea's Mammoth for two or three years say it is so much larger and more productive than other varieties that it is destined to displace them. All varieties of Quince are very hardy. As the blossoms do not appear till June, there is never any danger of injury from late spring frosts. It would be worth while to experiment with *C. japonica* and *C. Maulei* by grafting them on the Quince as a stock, and also by using them as stocks for Pears or Apples. The Chinese Quince, *C. sinensis*, is rather tender in our climate, and the fruit appears to be slightly gritty. In shape the fruits of this kind are unique, being fully 6 inches in length and perfectly cylindrical. A cor-

respondent of the 'Gardeners' Chronicle' for 1845 quotes an authority who states that the Chinese varieties of the Quince are said to be in some cases delicious in flavour even when uncooked. I cannot vouch for the truth of this statement; but there are numerous varieties in cultivation in Europe, and one would think such a handsome fruit in appearance, and one possessing such a grateful odour, could be much improved by good culture and possibly by seminal variation. It would be interesting to subject a small tree to pot-culture in bush form, as artificial heat might improve its flavour. It is rather singular to observe that while many of our Pears are deliciously perfumed, we have but little odour in our Apples, although many of them possess exquisite flavour. It has occurred to me that by growing bush Quinces in pots along with some of our finer Apples, we might by carefully hybridising them reciprocally (if that is possible) obtain a race of varieties possessing a grateful odour. Whether hybridisation could be effected between the Apple and the Quince is, of course, questionable, seeing that the Apple does not make a healthy growth on the Quince; nevertheless the experiment is worth carefully trying. It is curious to find that in many French nurseries seedling White-thorn stocks are used on which to work Quinces intended as fruit-bearing or ornamental trees; while the Quince, besides being an excellent stock for many of the finer Pears, may also be used for the Cotoneaster, Medlar, and scarlet-berried Pyracanthas, such as *P. japonica*, and *P. crenulata*, a nearly-allied plant from the Himalaya. From the above it will be seen that the Quince has more elective affinity with the Pear, Cratægus, &c., than with the *malus* section of Pyrus. The Quince is generally used, and indeed makes an excellent stock, for *Photinia serrulata*.

Fragaria (*Strawberries*).*—This genus is very distinct from other Rose-worts, as its seeds (fruits) are borne on the outside of a fleshy receptacle—a case opposite to that of the Fig; indeed, a Strawberry resembles the fruit of a Fig turned inside out. The cultivated varieties have originated from our native wild-wood Strawberries (*F. vesca*), and the Hautbois (*F. elatior*), the Virginian or Scarlet (*F. virginiana*), the Pine (*F. grandiflora*), and the Chilian Strawberry (*F. chiliensis*). The Alpine or Ever-bearing Strawberry, so much cultivated in French gardens, is by some made a variety of *F. vesca;* but Decaisne figures it as distinct, in the 'Jardin Frutier du Muséum,' under the name of *F. alpina*. All the species are so much alike, that

* For an account of the species of esculent Strawberries, by the late T. A. Knight, Esq., see Trans. Linn. Soc., xii. 362.

it seems probable they are all forms of the same plant, the differences not being more than one may expect to see in plants grown for ages under different climatic conditions. The main differences are in the leaves, and in flavour. There is a green-fruited variety (*F. viridis*), found rarely in Europe, and this bears round fruits very profusely, and, as it possesses a distinct Pine-apple-like flavour, it might be useful for hybridising. The Hautbois race bear most copious crops of fruit sometimes; but if grown in rich soils, the stamens are imperfect, and no fruit or but a poor crop is the result. This is a curious fact, and one which bears out Mr Meehan's theory, that a weakened vitality favours the development of male organs in flowering plants. The fruit of the Hautbois race is rich and musky. The late Mr T. A. Knight concluded that all the large Scarlet or American Strawberries (of which *F. virginiana*, *F. chiliensis*, and *F. grandiflora* are the supposed species or types) were referrible to the same species, since not only did they interbreed indiscriminately in his garden, but he demonstrated that similar varieties may be obtained from seeds of any one of these so-called types. In 1818 Mr Knight had four hundred varieties of seedling Strawberries in his garden (see 'Trans. Hort. Soc.,' iii. 207).

In America, Marshall P. Wilder has succeeded in crossing the Hautbois with some of the scarlets, the object desired being the infusion of the rich flavour of the Hautbois into the larger scarlet kinds; but no useful varieties have as yet resulted from this union. In 1866 (July 17) a new Strawberry was exhibited at South Kensington, named "Goodwin's Hybrid." It was raised by Mr T. Goodwin, gardener to Miss E. Backhouse, Holgate House, York, from seeds of *Fragaria lucida* fertilised with pollen from the "Elton Pine." The fruit was about the size of the Hautbois, the seeds being rather deeply imbedded. Although not possessing any very distinct merits, this seedling is interesting to the hybridist.

The Virginian or Scarlet has given us a very valuable race of varieties, one called the "Old Scarlet," and probably the type as introduced, having been the only one cultivated for two centuries after its introduction in 1629; and previous to this date it seems probable that our native varieties were the only ones grown or gathered wild for their fruits. The first varieties of this race were accidentally obtained, and now, by repeated artificial crossing and careful selection, they are very numerous.

The Pine Strawberry was introduced from Carolina, although by some it is said to be a native of Surinam. The true Old Pine or Carolina is one of the finest-flavoured of all kinds, and

the flesh is quite solid and juicy, so that a greater weight of fruit of this variety is obtained from a given area than of any other. The "Scarlets" and the Pines have given numerous hybrid varieties.

Cuthill's Black Prince is most prolific and very early, but the fruit is small. Crossed with the modern large-fruited forms, such as "Sir Joseph Paxton," "Dr Hogg," "Lucas," "President," or others, which are now sent out every season, it might be made to produce a race of early large-fruited forms. The best of the agreeably acid Alpine varieties so common in French gardens might also be made to give us a late-fruiting race, if crossed with "Elton," "Frogmore Late Pine," or other late kinds. What is most to be desired, however, is a race of large-fruited kinds, possessing the rich, brisk, sugary flavour of "Myatt's British Queen," which is still, without exception, the finest-flavoured Strawberry in cultivation, but only suitable for rich warm soils: on light sandy soils it is a failure as a rule. "Dr Hogg" and "Carolina superba" belong to the same race, and are delicious. These also might be utilised by the hybridiser.

The Chilian Strawberry was originally introduced to France (Marseilles) from Chili in 1712, but is now known to extend along the western coast of North America, California, and Oregon. In 1857, nearly 500 acres of this kind were cultivated near Brest alone. In its original state it was too tender for our climate, but seedlings were raised by crossing it with other varieties, one of the earliest and best of these being "Wilmot's Superb." And that finest-flavoured of all Strawberries, "British Queen," also resulted from hybrid varieties between this and other cultivated sorts. Dr Spruce, the South American traveller, observes that "the Ever-bearing Andean Strawberry, from the highlands of Mexico, is doubtless one of those varieties of *Fragaria vesca* commonly cultivated throughout the Andes within the tropics, where the perpetual spring of that favoured region has had the effect of rendering the Strawberry perennially fruitful, and many of the deciduous-leaved trees of Europe evergreen. In the equatorial Andes the province of Ambato is famed for its Strawberries, which equal in size and flavour some of our best varieties, and are to be seen exposed for sale in the market-place of Ambato every day in the year. They are cultivated at an altitude of from 7000 feet to 9500 feet above the sea, where the mean temperature of the year ranges between 59° and 67°; but the best are grown a little way out of Ambato, as you go towards Guayaquil, on the slopes of Guachi (lat. 1¼°

S.), at near 9000 feet, and in a mean temperature of 60°; where, however, the thermometer does sometimes descend, perhaps half-a-dozen times in the year, to the freezing-point in the early morning, scarcely ever on two successive days."

Fragaria monophylla, which has single leaves instead of ternate or trifoliate ones (see 'Botanical Magazine,' t. 63; also Duchesne, 'Hist. Nat. des Frais,' p. 124), appears to have been originally raised by Duchesne at Versailles, in the year 1761, from seeds of the Wood Strawberry. The fruits are oblong, larger than the last-named.

By cultivating the European Alpine varieties, Strawberries may be had from June until September; and by cross-breeding these with other varieties, the fruit might be much improved in size and flavour.

The Strawberry is one of the easiest of all plants to propagate; indeed it rapidly propagates itself, by means of young plants produced by its "runners." These are either allowed to root into the soil and then dug up and planted, or layered on pots of earth, by placing the young plant on the surface of the compost, and securing it with a stone or small peg; but a stone is best, as it preserves a certain amount of moisture around the young plant, and so enables it to root more quickly. New varieties are only to be obtained from seed, and careful crossing or hybridising is the surest way of producing improved forms; although chance seminal variation now and then gives improved varieties in these, as in other fruits. Cross-fertilisation is best carried on by growing the plants in pots, under a frame or in a cool propagating-pit, as they are then more easily protected from the influence of foreign pollen.

The seed can be separated from the pulp by paring it off as thinly as possible, and then rubbing it in dry clean sand to separate it, after which it should be sown at once in well-drained pans or boxes of moist sandy earth, and placed in a moderately warm temperature of 60°-70°, until it germinates, after which place the pans on a sunny shelf in a greenhouse or vinery from which frost is excluded, until they are large enough to prick off into beds of light rich earth in the open air, which will be about May or June. Some prefer to keep the seed until the spring, and in this case bury the fruit in a box of sand, and rub sand and seeds up together, and sow in boxes, or else pare off the seeds as before advised, and then separate the seeds from the pulp by rubbing in a fine clean cloth. The seed can be preserved in a box, or, better still, place it in a small bottle, and cork securely, and sow in pans in heat in the spring—say, February—so as to get

the young plant up early. Numerous new varieties are raised annually by both English and Continental growers. M. F. Gloede and Dr Roden have both produced some fine fruits. The late Dr Nicaise, a well-known French horticulturist, raised many fine varieties, which were principally distributed by M. Vilmorin & Co.

Mespilus (*Medlars*).—A genus of ornamental-flowering or fruit-bearing trees, mostly natives of Europe. The edible-fruited forms are varieties of *M. germanica*, and that known as the "Nottingham Medlar" is one of the best. They form low spreading trees, and are very ornamental in the early summer, when studded with large snowy-white flowers, nearly as large and somewhat resembling in form those of a wild rose. They are propagated by layers, hillock-layering being preferable where a large quantity of plants is required. Seeds grow freely, but do not germinate until the second spring after they are sown; so to save room they are frequently buried in trenches for a year, and then sown thinly in shallow trenches in nursery beds. Grafting (cleft) in April, or shield-budding in July, are the most generally adopted methods of propagating the fruiting varieties, the best stock being seedling Pear and White-thorn, as clean and as straight as possible. The Quince stock is also worth a trial for bush-trained trees. In budding, select plump or well-formed eyes, and carefully disbud the stock below the junction, keeping the head also within bounds, so as to favour the union as much as possible.

M. (*Eriobotrya*) *japonica* (Loquat), or Chinese Medlar, is a very handsome evergreen plant, somewhat resembling some of the large-leaved Sikkim Rhododendrons in habit. This is best propagated by grafting on the Quince stock, pieces of the partly-hardened growth being selected for scions. In order to prevent any undue evaporation, the large leaves of the graft should be cut in half, and a close frame or *cloche* is necessary to insure success. This plant may be fruited with tolerable certainty if subjected to pot-culture, and grown in an orchard-house or conservatory. Its large deep-green foliage, and clusters of bright-yellow egg-shaped fruits, render this one of the most effective of all ornamental and edible-fruited plants. It is a native of China, and possibly also of Japan, where it is cultivated. Although the Loquat is generally worked on the Quince, it does well on the Pear stock, and possibly the White-thorn might also be useful as a stock in an emergency.

Prunus.—A genus of shrubs or small-growing ornamental or fruit-bearing-trees, bearing white or pale rosy flowers, and, like some other of our hardy fruits, very widely distributed in

nearly all temperate countries. In China and Japan wild Plums are found, as also in the North American States, where the genus is represented by *P. americana*, *P. chicasa*, *P. maritima* (sometimes also called *P. pumila*, on account of its low bushy habit of growth), and numerous varieties which have arisen from self-sown seed, and which vary very much in size, colour, and flavour. In South America, again, other forms of Prunus are found, as also in North India; and in Europe we have numerous forms of *P. domestica* and *P. insititia* (Bullace), not to mention the common "Sloe" bush or "Black-thorn," *P. spinosa*, the fruit of which produces an excellent wine. The Plum, like most other of our common fruits, has been cultivated during a lengthened period, and during that time has given rise to numerous races and varieties. Thus we have at least a dozen well-marked forms of the "Greengage;" * some large, others small—some highly coloured, others with transparent flesh, or subject to other variations—and these form a tolerably well-marked and permanent race. The "Damsons," again, are a distinct group; and the large-fruited red or yellow "Egg Plums" or "Magnum Bonums" are also distinct, although they do not reproduce themselves by seed so permanently as do the last-named.

Some varieties of Plums come tolerably true from seed, more especially the Greengage, German Prune, Mirabelle, Myrobalan, and the common Damson, which is generally raised from stones. Both Greengages and Damsons are very variable; Guthrie's Late or Striped Gage and the Transparent Gage being very beautiful and distinct forms of the one, while of the common Damson we have many varieties, a fact which every fruit-grower must have repeatedly noted, and which is accounted for by the fact that it is rarely worked, being mostly raised from stones, large numbers of the seedlings being used, however, as stocks for other Plums, as well as for Peaches, Nectarines, and double-flowered *Prunus sinensis*. Seedling Damsons vary in size and shape of the fruit, sweetness, and flavour, as well as in habit of growth, while some varieties are ripe fully a month earlier than others. This prolific and useful fruit might be much improved by carefully selecting the largest and best-flavoured varieties, after which they could be perpetuated by grafting, and the season of the fruit in a fresh state might also be much prolonged by selecting the earlier and later varieties.

The Myrobalan or Cherry Plum, so much used as a stock,

* According to M. Carl Koch, the "Greengage" Plum is a variable wild Caucasian species.

thousands being raised annually from seed (stones) for this purpose, is evidently as distinct as the Sloe (*P. spinosa*), for it varies but very little from seed. There are indeed two varieties, one bearing greenish-yellow and the other clear yellow Bullace-like fruits. The greenish-yellow-fruited form is common in France and Belgium, grown under the name of Mirabelle, its fruit forming an excellent conserve; and it is also very largely multiplied from cuttings, which root freely in moist peaty soil, and used as a stock for Plums, Peaches, and Apricots. It appears to be a native of the Himalayas, and possibly also of China and Japan.

The American Beach or Sand Plum (*Prunus maritima*), a small tree, which will flourish on the poorest of sandy soils, especially near the sea, deserves an intelligent trial as a stock for the larger-fruited varieties of *P. domestica*. It forms a low bush or small tree on the sea-coast, extending from Maine to the Gulf, and bears large quantities of Cherry-like fruits of a red or reddish-purple colour, covered with a rich blue bloom. The fruit is very much prized for preserving, and even if seedlings from it do not answer as stocks, there seems no reason why this species should not be improved by hybridisation or selection, it being especially adapted for culture on barren coast-lands, where little else will vegetate.

Prunus armeniaca (Apricot) is a native of the mountains in Armenia, and is the *Præcocia* of the Romans, while Pliny remarks that it was grown in Italy in his time. This fruit does not appear to have been known in England until 1524, when Woolf, gardener to Henry VIII., introduced it from Italy. The Apricot, like the Almond, differs in having varieties with both bitter and sweet kernels. Thus the "Breda" and a variety cultivated in Upper Egypt called the "Musch-Musch," "Amande Aveline," and some others, have sweet kernels, which may be eaten like sweet Almonds; while the "Moor Park" and others have bitter kernels. The Apricot is very distinct in foliage and wood from all the other species of *Prunus* or *Amygdalus*, and the granular pulp of the fruit is another distinction. Its leaves, indeed, more resemble those of the Lombardy Poplar than any of its own allies; but its near relationship to the Plum and Almond and Peach is proved by the fact that it succeeds perfectly when grafted on either the Muscle or Common Plum as a stock; and, as we have previously noted, either Peaches, Almonds, or Nectarines may be grafted on the Apricot as a stock; and two or three centuries ago the Red Roman Nectarine, then the rarest of hardy fruits, was found to succeed best when grafted on an Apricot branch which had

itself previously been grafted on the White Pear Plum. Lindley, in his 'Orchard and Kitchen Garden,' remarks that neither the Brussels nor the Brompton Plum stocks should be used for Apricots, as the trees grow well only for a year or two, and then die off. Now, nearly all the Apricot-trees grown in our gardens are grafted on the Muscle Plum, while some nurserymen adhere to the Myrobalan, and others have equal faith in the Brussels stock. In French and Belgian nurseries the St Julien Plum is used as a stock, as is also the Black Damson, both propagated from seeds, and the Myrobalan Plum from cuttings. Some of the Continental nurserymen, however, value the seedling Apricot as a stock, and others the seedling Almond. I wrote to Mr Charles Lee of Hounslow, who, perhaps, understands fruit-tree stocks as well as anybody does understand them at the present time, and he tells me that he is now investigating, or rather demonstrating, this vexed question of stocks in his nursery. "We have," he writes, "numerous experiments going on, but these take a long time to eliminate—first, as to the taking of the bud; second, as to the free and healthy growth of each kind; and lastly, as to the average fertility and durability of the scion on the different stocks when the tree has got into a bearing state. Nothing but long practice in a *variety of soils and situations* can settle these matters." Grafting or budding may be performed in March and April, and the stocks which miss can be shield-budded in July or August. M. Baltet observes, that "where it is desired to obtain a tall standard Apricot on a low Plum stock, the latter should be first budded close to the ground with some variety of Plum allied to the Apricot, such as Reine Claude de Bavay, St Catherine, or other vigorous stock, which will serve as an intermediate stem, and on this the Apricot can be budded in at least two years' time." It does not appear to be well known that Apricots come tolerably true from seed, and bear large and regular crops of fine fruit grown on their own roots, and the trees so raised are more fertile and healthy than grafted specimens. Seedlings fruit the fourth or fifth year, and it is rare to see a decayed branch on seedling trees. For a valuable paper describing seventeen of the best Apricots, see 'Trans. Hort. Soc.,' 1835, p. 56.

Prunus salicifolius is a half-hardy Mexican species, bearing succulent fruits resembling Apricots, and these are sold in Mexican markets under the name of Capulinos. It is worth attention as an orchard-house tree, and it might possibly be useful to the hybridiser. It has been introduced to the Jardin des Plantes (see 'Revue Hort.,' 1866, p. 400). According to

some authors, the Willow-leaved Plum (*P. salicifolius*) was introduced to this country from China in 1822. The hybridiser who wishes to improve our Plums and other hardy fruits should not forget that Wild Plums, Apples, Strawberries, Apricots, and Grapes are found widely scattered over the earth's surface, and these are as capable of being improved as our own wild forms of hardy fruits were when in their original state. It is a pity we have no national garden in which to introduce and cultivate the wild Plums of America and other temperate countries, as some of these might form valuable stocks, or by crossing them with existing forms we might originate new and perhaps hardier or later-blooming races. As a rule, all Plums bear enormous crops in favourable seasons; but, unfortunately, nearly all our cultivated varieties require either to be eaten as soon as ripe or else to be preserved in syrup or sugar, by which operation much of their fresh, delicate, and juicy flavour is destroyed. We have one or two varieties, however, of which Coe's Golden Drop and Coe's Late Red are examples, which may be preserved in a fresh state for two or three months, or even longer; indeed, G. Lindley, in his 'Guide to the Orchard and Kitchen Garden' (one of the most original and valuable of all works on fruit-trees), mentions that Coe's Golden Drop has been preserved for nearly a year by wrapping each fruit separately in soft dry paper, and placing them in a dry place. I have repeatedly seen both varieties added to the Christmas dessert, the only preservative measures resorted to being to string them on laths, and hang them up in a dry airy fruit-room. There seems to me a field of improvement open in this direction, and all who raise new Plums might do worse than turn their attention to the production and multiplication of these late varieties, in the fruit of which there is already implanted a long-keeping tendency. It is singular to find this point so little attended to by horticulturists, if we except the case of the Grape Vine, to which of late years several very valuable varieties—notably Lady Downes's Seedling—have been added. Surely if such a soft juicy fruit as the Grape can have long-keeping properties infused into it by cultivation and cross-breeding, this might also be done in the case of the Plum, and many other fruits which come in all at once, and force us to eat them from the tree as the only means of enjoying them in a fresh and natural state.

P. sinensis, or Chinese Plum, is a hardy shrub or small tree, of which we possess very beautiful double-white and rosy-flowered forms. All the ornamental-flowering or variegated-leaved varieties of *Prunus* may be readily multiplied by budding or

grafting in the ordinary manner on common Plum or Myrobalan stocks. Herbaceous cuttings inserted in a close shady frame in June or July often succeed.

Prunus obovalifolia is a seedling of *Prunus spinosa*, raised by M. Carrière, and differing from the parent in being entirely devoid of thorns, and having broadly oboval leaves and larger flowers. The tree is very vigorous, with a remarkably straight stem and spreading branches, covered with a red and very shining bark. It first bore fruit in 1872, seven years from the time of sowing. M. Carrière is of opinion that our garden varieties of the Plum must have sprung from a stock similar to this, the received notion being that our thornless Plum-trees are merely one of the results of cultivation.

Seedling Plums raised by Mr Rivers.

Autumn Compote.—Oval; very large; bright red and handsome; abundant bearer; ripens two or three weeks after Victoria: a valuable late kitchen Plum.

Blue Prolific.—A culinary blue Plum; a profuse bearer. This variety is distinct; it has the property of hanging on the tree during several weeks and being fit for use all the time: frequent gatherings may be made from the beginning of August until the second week in September.

Early Favourite.—Roundish oval; medium size; purple; juicy and very agreeable; freestone; requires a wall with S. or S.W. aspect, and is then the earliest of all early Plums. Middle of July.

Early Rivers, or *Early Prolific.*—Oval; purple; medium size; juicy and good; freestone: this was raised from a stone of the Précoce de Tours; hardy, and a prodigious bearer. End of July. It is one of the heaviest Plums known, although not of a large size. The bushel weighs from seventy to eighty pounds, the weight of ordinary Plums being about sixty pounds to the bushel. This density renders it the most valuable Plum for preserving. As a preserve, or for cooking, it is unequalled in flavour.

Early Transparent Gage, or *Early Apricot of Dr Hogg.*—A seedling from the Transparent, of equal excellence; ripens before the Greengage; a great bearer, and very hardy. The fruit is produced in such profuse clusters, that thinning, as for Grapes, must be practised. Middle to end of August.

Late Prolific.—This is a seedling from the Early Prolific, of equal excellence, but ripening three weeks later, thus continuing the season of one of the best cooking Plums.

Later Rivers.—Below medium size; round; dark purple. almost black; juicy; rich and good; one of the latest Plums. November.

Rivers's Early Damson.—A seedling from St Etienne Plum; a charming addition to Damsons. Early in August.

Sultan.—A seedling raised from Belle de Septembre. Large; round; deep red; very productive. Middle of August.

The Czar.—A very large early purple Plum; ripening about the end of July; rich and good; very productive. This Plum will prove very valuable to all planters; it is as large as the "Black Diamond," and the tree is hardy and robust in growth. The fruit is not liable to crack like the Early Orleans.

Crittenden's Prolific Damson.—This was raised many years ago by Mr J. Crittenden of East Farleigh, and is said to possess extraordinary bearing qualities as compared with the sorts usually grown, so much so, that of late years many growers have done away with the Prune, Shropshire, and other Damsons, and introduced Crittenden's, which is so popular in the district that every year a stock of it is raised from suckers, which can be had in any number. Its free-bearing character and its qualities as a fruit are well attested; when the fruit begins to swell, the branches have in many cases to be propped up, to prevent their breaking.

Pyrus.—A genus of Rosaceous fruit-trees indigenous to Europe and Northern Asia, the wild forms of *P. communis* (Pear) and *P. malus* (Apple) having given rise to thousands of cultivated varieties. Those interested in the many forms of wild and cultivated Pears, Plums, Peaches, and other hardy fruits, should see the beautifully-engraved plates in the 'Jardin Fruitier du Muséum,' a magnificent work transcribed in the best of all languages from specimens in a good national garden—Jardin des Plantes—by Professors Decaisne and Riocrieux. The Apple, more especially, is one of the most valuable and wholesome of all our cultivated fruits; and, like the Orange of Italy and Spain, its value is increased owing to the length of time its fresh fruits may be had in perfection—that is, all the year round; indeed, one variety called the "French Crab" will keep two years, and seedlings or cross-bred varieties from this variety ought to give us a race of valuable keeping Apples. Apples and Pears are propagated from cuttings much more readily than is by many supposed; and some varieties which form knaurs on their branches, as the "Bur Knot," strike root so readily that large branches three to four feet in length may be taken off and put in for cuttings with success. These large

branch cuttings should be planted deeply — say, a foot or eighteen inches—so as to be beyond the influence of surface drought, otherwise they will not root well. Cuttings are best taken off in the autumn or winter when pruning, and may be buried in sand until spring, and then planted in rows under a north wall or fence. New varieties are only to be obtained from seed, and the seedling plants vary much not only in the size and flavour of their fruits, but in hardiness and habit of growth. If only a few seeds are to be sown, cut open the fruits and pick out the seeds, which can at once be sown in pans or boxes of rich earth, and placed in a cool frame. Where flowers have been carefully crossed, due precautions having been taken to prevent self-fertilisation or cross-fertilisation by wind or insects, the chances of valuable new varieties are much better than when seeds are gathered indiscriminately from sorts, however good, which have not been so treated. Where large quantities of seeds are sown for stocks, it is customary to bury the fruit in autumn, so as to cause the pulp to rot—this being dug up in the spring, mixed with sand or dry earth, and sown in rows in the nursery or seed-beds, the young plants being thinned and transplanted in due course, either for fruiting or as stocks for well-known kinds. In order to save time in fruiting seedling plants, graft them on Quince stocks the second or third year from seed. As will be seen from the following extracts, seedling Apples and Pears should be kept for a year or two after they first fruit, as they often improve very much as the young trees develop themselves.

M. Gilbert gives the following interesting details on seedling Pears in 'Les Fruits Belges:' "The Abbé Hardenpont of Mons was the first of the race of Belgian fruit-growers. In the last quarter of the last century, he obtained from seed the Beurré de Hardenpont, the Passe-Colmar, the Beurré Rance, and the Delices d'Hardenpont, some of which still hold places of the first rank in advanced pomology. M. Van Mons, of Louvain, quickly followed, having, between 1787 and 1854, raised five hundred kinds of new Pears, several of which are of the highest class. M. Beront, between 1845 and 1854, produced within that decade no less than sixty new kinds; in 1828 he produced Le Delice de Flays, which is even finer than Les Delices d'Hardenpont. The Society Van Mons only produced eleven new Pears during the sixteen years of its existence, showing that individual perseverance is very generally more successful than combined efforts. M. Gathoge, of Liège, produced in 1852 Beurré Edouard Morren. In 1828 M. Magnere obtained from seed the Poire Rénoz, a good and

fertile summer kind; and M. Henrard, as early as 1840, introduced his Bon Chrétien and Vernois, said to have been received from France. M. Lagepont, of the Commune of Charneux, produced in 1800 the celebrated Fondante de Charneux. The Bon Chrétien Lamarche was found in a convent garden of the province of Liège, where its origin was unknown."

We advance but slowly in new good kinds of Pears; for not more than five per cent of the new varieties raised from seed on the Continent are adapted for universal cultivation. Some kinds are good in the south of England, and never good north of Trent. Still they are so capricious in their choice of site and soil, that in many valleys in Scotland some kinds ripen well, and are of better quality than they are in the north-east of England.

There is a curious fact relative to the change of quality in some kinds of Pears newly raised from seed—many are found to improve with age, while others deteriorate. This was found to be the case by the early raisers of seedling Pears in Belgium in the last century. I now refer to it because the Prince Albert Pear, which was at first so promising, now, after a lapse of ten or twelve years, seldom or never ripens its fruit. This is the case with some others, which it was hoped would prove valuable late Pears. Bezi Mai, Beurré Bretonneau, and Prince Camille de Rohan, must be considered baking Pears. It is not our cooler climate alone that has brought on these changes; it is the nature of the varieties. Winter Nelis has seldom or never varied, neither has Beurré d'Aremberg.

Pear Stocks.—Quince from cuttings, hillock-layers, or seed; Pear or free stock from seed; and rarely White-thorn (*Cratægus oxycantha*) from seed (haws). Clean straight young stocks are obtained by planting out the stocks in autumn or spring, and heading them down, when they send up fresh young shoots, which can be either budded or grafted. The best time for crown or whip grafting is in March or April—and for budding, July and August. Grafts which have not taken in the spring can be replaced by buds in July or August; and if these fail, graft again close to the ground in spring. Scions or grafts may be preserved by burying them in sand in a cool shady place, under a north wall, but not where they are subject to drip. Pieces of Pear roots four or five inches in length, with a few fibres at the lower end, may be used for stocks on an emergency, and are always readily obtainable where there are old standard espalier or wall-trees. Always bud or graft close to the ground on the Quince.

There are at least half-a-dozen forms of the Quince, differing

considerably in habit, and it is worth while to test these by experiment, so as to discover which is best as a Pear stock. Being different in habit, they might each suit particular varieties better than others. The common Quince is generally used in this country, while M. Jourdain prefers a French variety named La Quintaine, and other fruit-growers prefer the Portugal or the Angers' variety.

As to the duration of Pears on the Quince stock—a by no means unimportant question—Mr Rivers says: "I have so often heard from market-gardeners and others the sentence, 'It is of no use to plant Pears on Quince stocks, for they will not live long,' that whenever I have seen Pear-trees of a mature age, I have looked to the stock to ascertain its nature, and whether it was Pear or Quince or White-thorn, for I know of some healthy free-bearing Pears grafted on the latter. In the kitchen-garden of the Deepdene, near Dorking, I observed a number of fine pyramidal Pear-trees. These I soon found to be worked on the Quince, and the gardener there informed me that they had been planted about thirty-four years. They are very healthy, and are growing in a soil of the driest and lightest description, being nearly pure sand. The trees were imported from France. Now, presuming their age to have been three years (the usual age) when planted, they are now nearly forty years old, and most certainly appear as if they would live and grow and bear fruit for twenty years to come. A light porous soil resting on a cool subsoil is, I have reason to believe, the most favourable for Pears on the Quince stock; so that, if the soil of a garden in which they are to be planted be heavy and stiff, they should be planted in a light compost, or Pears grafted on the Pear stock only should be grown to prevent disappointment." For a list of the Pears which succeed on the Quince stock, see the 'Garden,' 1873, p. 352, 353.

Mr Rivers, who was one of the first to introduce the culture of the Pear on the Quince stock recommends "double-grafting" in the case of such varieties as the Jargonelle, Marie Louise, and others, which are apt to overrule the Quince stock when budded or grafted upon it directly. All cultivators know how difficult it is to make some varieties of the Pear succeed on the Quince. M. Carrière has lately pointed out an easy road to success in this matter—namely, always to operate by cleft-grafting instead of by budding. By this means, in the case of those varieties which exhibit a reluctance to unite with the stock, the disastrous effects of high winds are avoided, and the union of the scion with the stock is secured sooner and more permanently. The following

curious note on this subject has been sent by a Mr Tipton of Burlington, Kansas, to the 'Horticulturist' (New York): "Pears grafted or budded on bearing Apple-trees is the quickest, surest, and cheapest way I ever grew Pears. I never picked better Pears from standards, or any other under-growth for the Pear, than I have picked from old Apple-trees topped and budded or grafted with Pears; and they always bore early and profusely. In large Apple orchards are sometimes found worthless, scraggy trees: on such I have practised changing to Pear. I never failed in two years to get a good crop. In some trees the Pear would die out in five or six years, while others were healthy to my knowledge for eighteen years, and still doing well the last time I saw them, in 1865, in Franklin county, Ohio."

M. Stole, Director of the Pomological Institute of Proskau, writing in the 'Monatsschrift' for March 1876, recommends grafting the Pear on vigorous young Apple stocks, the chief merit being early and increased productiveness at the cost of longevity. This plan is said to find favour with many practical fruit-growers in Prussia and Poland; and at Czerventzitz, near Posen, the writer saw considerable plantations laden with handsome and high-coloured fruit.

M. Carrière, writing to the 'Revue Horticole' in 1871, mentions two Pears—Beurré de Malines and Beurré Spence or Fondante de Bois—which have done well grafted on the Doucin or Apple stock since 1856, the bark being clean and free, and the trees bearing fine crops of excellent fruit. The professor, in condemning the sweeping generalisations as to the incompatibility of the two trees as stock and scion—generalisations formed on a few, and in many cases imperfect, experiments—recommends that fifty varieties of Pears be taken, and two of each kind cleft-grafted on the Doucin or other Apple stock, and two of them inserted by shield-budding. Both cleft-grafting and shield-budding are recommended, because different results often follow the two operations.

M. Carrière's statement is corroborated by a correspondent of the 'Gardeners' Chronicle,' 1871, p. 836, who inserted buds of Pears Marie Louise and Fondante d'Automne on Apple stocks, and both varieties were growing vigorously a year after they had been worked.

Double-grafting will ultimately have a great effect on Pear-culture in gardens. It seems always to make healthy and prolific trees. It must not, however, be concluded that to graft a free-growing sort of Pear on the Quince, and then to regraft it with the desired sort, will always answer. Some

kinds require the stock belonging to their race. This can only be found out by the clever cultivator—as, for instance, the Jargonelle on the Beurré d'Amanlis, the union of which is so perfect, and the trees thus formed so healthy, that an acre of double-grafted Jargonelle Pears would be a little fortune to a gardener. Gansel's Bergamot double-grafted becomes a marvel of fertility; and the sorts raised by the Rev. Mr Huyshe, all of which are of great excellence, become most fertile trees when double-grafted on the proper kind of stock. When this scientific method of cultivating Pears is fully understood, those who introduced the culture of the Pear on the Quince stock will have warm thanks from all lovers of fruit-tree culture.

M. Baltet also recommends this method: "When the variety to be propagated is a tender one, such as Esther Compte, Brandes, Beurré Flou, Seckle, Van Mons, Bon d'Eyée, Madame Millet, Prévost, and others, we graft as an intermediary some hardy and vigorous variety, such as Duc de Nemours, Beurré d'Amanlis, Beurré Hardy, or Napoleon Savinien. These, grafted close to the ground on the Quince, soon rise into a stem, and after at least two years' growth are crown-grafted with the desired tender-habited variety." The same plan also answers for those varieties which do not form a good or perfect junction with the Quince stock.

Another Continental nurseryman, M. Jourdain, adopts a method which is by no means a common one for the establishment and formation of his Pear-trees. He raises them in his own nursery, the Quince serving as the stock; upon this he grafts the Curé or Belle de Berry, upon which finally is grafted the variety chosen. It is true this plan is not altogether a new one. Many other vigorous-growing varieties are often used for super-grafting—as, for example, the Jaminette, Sucré Vert, Beurré d'Amanlis, &c. A rapid growth is thus obtained with varieties that push slowly when grafted on the Quince or upon seedlings. Amongst these may be mentioned. Beurré Clairgeau, Beurré d'Angleterre, Bon Chrétien Rance, or Beurré Noirchain, and others. But M. Jourdain's system differs from others, inasmuch as he allows the first graft—that is to say, the Curé—to grow vertically; and, in order to obtain the tiers of his palmette, he inserts in the upright stem, at a distance of about ten inches apart, the buds of the variety he wishes to crop. By this means he is enabled to insure perfect regularity of form and extraordinary vigour. This satisfactory result is obtained by care in the choice of good one year's cuttings of the variety of Quince called La Quintaine, and by using the eyes of young and vigorous trees upon the young scion. It is

impossible to overrate the importance of exercising the greatest care in the choice of eyes. Whilst admitting that the method adopted by M. Jourdain is worthy of all praise, it may be remarked that it would be preferable if the variety chosen followed upon the second tier of branches placed upon the Curé, and was allowed to complete the shape of the tree. It is to be feared that, as often happens, the sap, flowing towards the centre of the tree, may weaken the lower tiers, and it would be better to place, for the formation of the last tier, a graft of a very productive but weak-growing variety. Experience has shown that the balance of certain forms may, by this means, be easily maintained.

Lindley remarks that in the Pear the fruit becomes lighter-coloured and smaller on the Quince stock; but this can only be on poor soils; while on the Medlar stock this difference in size and colour is more apparent still, and in these two instances the ascent and descent of the sap is obstructed by the Quince more than by the Wild Pear or free stock, and by the Medlar more than either; and he adds that similar effects are produced in the Apple by the Paradise and Siberian Bitter-sweet stocks; but, as we have already observed, dwarfing stocks like those just named are most useful on rich deep soils; while on poor soils, the robust, strong-rooting, or invigorating stocks are best.

Nearly every man who has now an orchard of Pears would like to change some of his trees for other sorts. Fortunately the operation of regrafting is remarkably simple and easy with Pear-trees, and by the insertion of twenty grafts, more or less, on each tree, properly distributed, a new and perfect bearing head may be obtained in two or three years. Instead, therefore, of digging up and throwing out such trees as do not bear good Pears, and leaving undesirable vacancies where they stood, they are readily changed to the very best. The first thing to do, after having secured the grafts, is to prepare the trees for regrafting, by trimming the branches, and cutting out any not wanted where they happen to be too thick. Then cut them off so as to form a regular pyramid, by leaving the bottom ones longest, and gradually tapering to the top. This operation can be extended over two or three years, if desirable, so as to secure fruit off the old tree until the new grafts come into bearing. If the branches are small, they may be whip-grafted; but usually they will be much too large, and will require cleft-grafting. We have seen large numbers of dwarf Pear-trees, which were eight or nine years old when worked over, that in three years were as perfect trees and as abundant bearers as those which had not been thus changed.

Those interested in intelligent Pear-culture on the Quince stock cannot do better than obtain permission to see Mr F. Dancer's fruit-garden at Chiswick, where hundreds of bushels of the very finest dessert Pears are annually sent to the London fruit-markets from bush or pyramid trees all worked on this stock. There is no comparison between the fruit produced by standard or orchard trees on the Pear or free stock and bush trees on the Quince.

Dr Bretonneau, of Tours, has succeeded in intergrafting Pears on *Cotoneaster affinis*, and also on *Amelanchier* as a stock. Attempts to graft them on evergreen Cotoneasters, such as *C. buxifolia* and *C. microphylla*, have failed. The Jargonelle and Josephine de Malines both succeed well on the White-thorn stock (see 'Gard. Chron.,' 1873, p. 1732).

A curious experiment in Pear-grafting is recorded in the 'Revue Horticole,' 1867 (see also 'Gard. Chron.,' 1867, p. 947). It appears that M. Carillet, of Vincennes, took two young Pears, each worked on the Quince, and one—Beurré d'Aremberg—was made to serve as the stock; the other—Beurré de Charneu—was dug up with care, and grafted by approach in an inverted position—*i.e.*, with its roots in the air, the head pointing downwards. This was in April; and during the summer the scion tree threw out buds and shoots from the Quince stock and root, and the stock grew vigorously and flowered, and bore two fruits. To add to the strangeness of the union, M. Carillet grafted the exposed roots of the Quince with two other varieties of Pear. This experiment shows that the sap passes through stems either towards the apex or towards the root with equal facility, and that roots have the power of living fully exposed to light and air, and throw out shoots like branches. No intermixture of individual characteristics seems to have taken place here, although the sap passed first from the Quince roots, then through Beurré d'Aremberg, thirdly through the *inverted* stem of Beurré de Charneu, then into the Quince stock on which the latter was grafted, and lastly into two Pear grafts.

For a very interesting essay on the variability of Pears, the result of experiments made in the Jardin des Plantes between 1853 and 1862, by M. J. Decaisne, see 'Jour. Royal Hort. Soc.,' new series, i. 36; or 'Annales des Sciences Naturelles,' 4 série, xx. 188 (1864). Several seminal varieties of the English Wild Pear are figured by M. J. Decaisne in the 'Jardin Fruitier du Muséum.'

Pyrus domestica, or "Witty Pear," of which there are at least two varieties, is apparently wild in Wyre Forest, and is

by some presumed to be a hybrid, of which *P. aucuparia*, or "Rowan-tree," was one of the parents. *Pyrus terminalis* may be grafted on the Mountain-ash (*P. aucuparia*), but is said by some cultivators to be better on its own roots.

The scarlet and yellow fruited varieties of the Mountain-ash (*Pyrus aucuparia*), or "Rowan-tree," as it is popularly called, are grafted on the seedling White-thorn (*Cratægus oxycantha*) stock; as also is the Service-tree (*Pyrus domestica*). The seedling or Wild Pear stock may, however, be employed. The modes of grafting employed are cleft or whip grafting in March, crown-grafting in April, close to the ground, and shield-budding in July in the open ground.

Pyrus hybrida.—There is a fine old specimen of this in the Fulham Nursery of Messrs Osborn & Son, which every autumn is laden with its showy fruit. It is said to be a hybrid between the Mountain-ash ("Rowan-tree") and the White Beam tree. Like its parents, it is readily propagated by grafting on the White-thorn stock; and probably the Pear or Quince stock might also be employed. *Pyrus japonica* is now referred to the genus Cydonia, or Quinces, along with *P. Maulei*, a native of Japan, similar in habit and fruit to *P. japonica*, except that its fruit is edible, and useful for conserves or marmalade, like that of its ally, the true Quince. *Pyrus japonica* is readily propagated by cuttings of the roots; and in the 'Gardeners' Chronicle,' 1872, p. 1321, a portion of the root of this plant is figured, bearing flowers and buds as well as roots. Many seminal forms, bearing white, crimson, scarlet, rose, peach, flesh, and salmon coloured flowers, have been raised in Continental nurseries. This shrub forms an excellent stock for *Chænomeles;* cleft-grafting in January or February, or shield-budding in the latter month, are most successful. A tree of Pear Henri Capron, in the Royal Horticultural Gardens at Chiswick, sometimes produces a very attractive display of semi-double flowers one year; indeed fully two-thirds of the flowers were in this state, those borne by one or two branches being entirely so, and the tree was far more conspicuous than any other of the numerous varieties on this account. If it were possible to perpetuate this tendency to semi-duplication by grafting or other means, it would be equally as ornamental as the double-blossomed Plums, Peaches, or Cherries. There seems a tendency to duplication of late years among cultivated plants; but by what specific causes this substitution of showy but useless organs for useful and sexual ones is brought about is still a mystery to the physiologist. In some plants over-luxuriance seems to favour the production of double forms, while the ex-

pert florists half starve their seed-bearing stocks in pots, and so obtain about seventy per cent of double varieties. *Pyrus spectabilis Riversii*, a beautiful spring-flowering tree, is a hybrid raised at Sawbridgeworth from seed of *P. spectabilis* crossed with *P. japonica*, and is similar to *P. spectabilis roseo-pleno.*

Mr T. A. Knight raised several good seedling Pears, a detailed account of which is given in the 'Trans. Hort. Soc.,' 1835, p. 103. Of these, Knight's Monarch is perhaps the best. Mr Rivers has also raised several useful sorts. Little has yet been done in the way of careful cross-fertilisation, most of the popular kinds now in cultivation being chance seedlings from self-fertilised flowers. See Hogg's 'Fruit Manual' (fourth edition); Scott's 'Orchardist;' Lindley's 'Orchard and Kitchen Garden;' also Leroy's 'Dictionary of Pomology,' and the 'Transactions of the Horticultural Society,' for the origin and history of Pears, Apples, and other rosaceous fruits.

Apple Stocks.—Seedling Apple or Crab stocks for standard or orchard trees. Seedling stocks are best, but hillock-layering is resorted to by some nurserymen in the propagation of Apple and Paradise stocks. Mr Rivers of Sawbridgeworth has raised two or three forms of the Paradise stock from seed, and he describes the Nonesuch Paradise and the Broad-leaved Paradise as being both remarkable for the fertility they give to Apple-trees. The latter is like the French Doucin, but has leaves less pointed; like the Nonesuch Paradise, it keeps pace with the graft, so that it does not swell over the stock, disturb the health, and shorten the life of the tree. These two varieties of the Paradise Apple were raised from seed here many years since, and they have proved of great value: from the same seed a variety was raised so dwarf as to form a perfect miniature Apple-tree; yet, like the French Paradise, which is not nearly so minute in its proportions, it bears our climate bravely, and has been named the Pigmy Paradise Apple.

The true French Paradise is now fairly established as the best dwarfing stock for choice Apples, such as Cox Orange, Reinette du Caux, Calville Blanc, and Ribston, and the fertility and beauty of young trees two or three years from the graft on this stock is most wonderful. Mr W. Robinson deserves the thanks of all intelligent fruit-growers for his efforts, which have led to its general adoption in this country. See 'Gardeners' Chronicle,' vol. xxviii. (1869), for interesting discussion on the best stocks for Apples. The Common Bur-Knot Apple forms an excellent stock for most Apples.

A very interesting collection of Apple stocks has been formed in the gardens at Chiswick by Mr A. F. Barron. Among these

are the following: Common Crab, which flowers in May; Dutch Paradise, a straggling grower, flowering in April; Rivers's Nonesuch or English Paradise, flowers in May; Rivers's Miniature Paradise, equally late; Scott's Paradise, a distinct pyramidal-habited variety, flowering in April; and the true French Paradise, of straggling habit as a tree, flowering in April, and bearing a medium-sized golden-yellow fruit of excellent flavour. (See 'Florist,' 89, 1875, p. 97, for excellent figure and description.) This last is one of the best of all stocks for bush, cordon, or espalier trained Apples, but is not suited for standard orchard trees. It exercises a wonderful dwarfing influence on any variety worked on it, and induces short compact growth and a profusion of blossom or fruit buds. It is an early bloomer, but this is not so desirable in stocks or fruit-trees as at first sight appears. As a rule, all our fruit-trees bloom *too early* for our climate, and as the result of this, we frequently lose our crops through the effects of severe spring frosts; and if we could transmit a late-blooming habit to our fruit-trees, either by working them on late-blooming stocks or otherwise, it is likely our chances of a regular crop of fruit every year would be materially increased. Early crops are readily obtainable under glass; but for our general crops, late-flowering and hardy kinds, which escape spring frosts, are to be preferred; and the question of stocks deserves careful study from all our fruit-growers.

The 'Gardeners' Chronicle' has the following remarks on this subject: Mr Dancer has been induced to plant large quantities of fine Apples and Pears on the Doucin, Paradise, and Quince stocks. The Chiswick soil is deep and holding, and highly manured, and where young trees on the common Crab or Pear stocks are planted, the result is seen in a coarse, barren growth that it is difficult to keep in check. On the other hand, trees on the foreign stocks give only a moderate growth, and fruit in great abundance, the fruit being second to none for size and quality. A most remarkable example of this divergence of character, as produced by stocks, we saw there a few days since. A number of small bush-trees of the Dutch Mignonne Apple, worked on the Paradise stock, have most marvellous crops of fruit, large and finely coloured. Some of these small trees had quite a bushel of fruit on them, and were literally borne to the ground with the weight. Yet close by were trees of the same variety worked on the Crab stock that had hardly a dozen fruit on them, but were at least of three times the size. The French stocks would hardly be suitable for poor gravelly soils; but in deep, rich loams, and

where manure is abundantly used as top-dressing, nothing can excel them in producing early and regular fruitfulness.

M. Decaisne ('Jour. Royal Hort. Soc.,' vol. ii. (new series), 1870, p. 55), in an interesting paper on the "Paradise Apple," says: "There have been no important and comparative experiments whatever on the grafting of the Apple or of the Pear. All that has been done in this direction has been confined to individual observation, the results of which have been taken as proved without verification."

In the nurseries of Germany and France, Pears and Apples sown for stock are mixed together; and everybody who tries it will find that both, but especially the Pear stocks, grow much better and more vigorous that way than by themselves.

The Apple may be grafted or shield-budded like the Pear, and the grafts should be gone over a fortnight or three weeks after the operation, and those that have failed may be replaced either by grafts or buds. The ornamental-flowering forms of *Pyrus spectabilis* or "Chinese Apple," and others, may also be propagated by grafting on common stocks. Apple scions may be preserved like those of the Pear by burying in sand, and roots may be used for stocks, as in the case of the Pear, if other stocks are not to hand. It is very possible that a good supply of stocks might readily be obtained by planting cuttings of Apple, Pear, or Plum roots in rows in nursery beds. After grafting on roots, tie firmly and paint the junction with wax or mastic, then plant the roots and scions, only leaving one or two buds of the graft above the soil. "Apples," says an American fruit-grower, "may be root or collar grafted successfully as follows: Seedlings grown on rich loamy soil, either one or two years old, are lifted when there is no frost in autumn, cleaned and stored in sand, in a cellar, and not so damp as to be liable to mildew. The scions should consist of the previous summer's growth. Cut them into four or five inch pieces, each having from four to six good, sound, perfectly-formed buds. The lower end of each of these pieces should be cut, as in ordinary grafting, and the roots cut about four inches long. The best piece is the one at the collar. At the upper end of each piece of root make a vertical cut upwards, forming a flat surface, into which, from the upper end, cut a slit forming a tongue, which will fit a corresponding slit previously made in the scion. With a little practice, any one can make the bark of the scion, and that of the root on the ends where the flat surfaces are formed, fit so closely that the sap of the one can flow into the other and produce the granulation or healing process without failure. The fitting can be done so that the union

will be quite strong; but to make the matter doubly sure, the best way is to tie with a string which has been saturated with hot grafting-wax. Pears, Plums, and Cherries may be grafted in this way, only the root should be left longer, and only the collar cut used. The next important matter is the proper care of the grafts. I have been most successful by packing them upright in a shallow box, say one inch deeper than the grafts are long, after dipping one-half of the roots into a puddle made of clay and fresh cow-dung, and filling up with sand, leaving about an inch of the scion above the surface. The boxes of grafts should then be stored in a dark part of the cellar until frost is over and the ground is quite ready to receive them." The Apple is the finest and most universally useful of all our hardy fruits; and lacking that great and much-to-be-hoped-for national garden, in which the rational principles of fruit-culture could be practically taught to our artisans, and from which scions or fruit-trees of the best kinds only could be distributed, let us hope that country gentlemen or clergymen will take up the subject of fruit-culture, and distribute trees to the working population who have gardens in their vicinity, or teach them how to raise stocks and graft them for themselves. Here is a field of noble labour for the philanthropist; and in the case of the country gentleman or landed proprietor who urges the culture of fruit-trees in the gardens and allotments on his estate, it brings its own reward. Surely while it is remunerative to import Apples from America, and dessert Pears from France and the Channel Islands, it would pay to grow them at home. An Apple-tree will grow in any hedgerow in the kingdom, it requires little or no care after planting, and will pay at least a hundred per cent more than hedgerow timber-trees, which in many cases are of no value except for firewood. In Belgium the railway embankments are now utilised for fruit-tree culture, and it is questionable whether any class of farming or market-gardening is more profitable than fruit-growing for market, as carried out by such intelligent cultivators as Mr F. Dancer or Messrs Rivers.

The Siberian Crab (*Pyrus prunifolia*) deserves the more close attention of fruit-growers and hybridisers for two reasons —viz., it vegetates very early in the spring and is singularly hardy in constitution; indeed, so marked is its power of resisting cold spring frosts that its blossoms rarely suffer, and a profuse crop of fruit is invariably produced. There are two well-marked forms—one bearing golden-yellow fruit the size of Gooseberries, while the other bears smaller bright scarlet fruits, and is popularly known as the "Cherry Apple." For orna-

mental purposes, and especially for planting on the margins of shrubbery borders or woodland walks, these trees are singularly beautiful in spring when a mass of rosy-white flowers, and in autumn when laden with golden-yellow or crimson-scarlet fruits. This hardy Apple is well worth a trial as a stock, or its hardy character might be infused into other larger-fruited varieties by hybridising. The late Mr T. A. Knight hybridised the Siberian Crab with Golden Harvey, and the result was "Siberian Bitter-sweet" and "Siberian Harvey," both worthless except for cider. Another cross with the Golden Pippin produced another worthless variety named "Foxley." More recently, however, a singularly handsome, highly-coloured variety of excellent flavour has been raised by Mr Jennings in his nursery at Shipston-on-Stour, from seed of the Scarlet Sib[illegible] Crab or Cherry Apple. The seed was sown with no in[illegible] of raising new varieties of fruit, but for stocks on [illegible] graft the ordinary varieties of Apples. One of these [illegible] signs of fruit, Mr Jennings grafted it upon a [illegible] stock, and from one of the trees so produced thi[illegible]as obtained.

The parent tree from which the seed was taken is growing in an orchard consisting of such varieties as Ribston Pippin, Wyken Pippin, Blenheim Pippin, Margil, Hanwell Souring, and Pearmain. That which is in closest proximity to it is Margil, and it is not improbable that this was the male parent (see 'Florist,' 1870, p. 49, for excellent figure and description).

Paul's "Imperial Crab" is a handsome and prolific variety (see 'Florist,' 1876, p. 13). It is a seedling raised by Mr R. Laing of the Twickenham Nursery, and is supposed to be the result of an accidental cross between the "Red Astrachan Apple" and the "Siberian Crab," the two trees standing close together with interlacing branches. It first fruited about 1865, and was sent out by Messrs Paul & Son in 1869. Like the Siberian Crab, the tree is very ornamental when in fruit, and its produce is valuable for preserving in various ways. All these hybrids between *P. malus* and *P. prunifolia* are very ornamental in spring when a mass of rosy flowers, and also in autumn when laden with crimson and golden fruit and bright yellow foliage. They should find a place in shrubbery borders and plantations everywhere.

Rosa (*Roses*).—A widely distributed and deservedly popular genus of flowering shrubs, found throughout Europe, Asia, and America. They are largely grown in India, Persia, and other Eastern countries, and extensively used in the preparation of otto or attar of roses, one of the most valuable of all vegetable

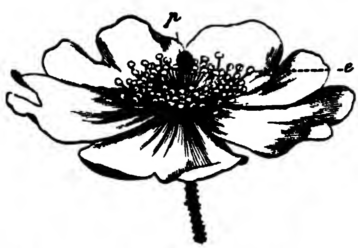
perfumes. The double-flowered varieties of *R. centifolia* (Cabbage or Provence), *R. indica* (China or Monthly), *R. canina*, var. *Bourboniana*, and others, are largely grown in our gardens, hybrids innumerable having been obtained and cross-fertilised with other varieties. Thousands of seedling Roses are raised in the Continental rose-gardens every year, and in this country many of the finest show Roses have been obtained from seed. At least fifty species of Roses are known, some of these—as *R. rugosa*, *R. Regeliana*, *R. bracteata*, *R. sempervirens* (evergreen), *R. alpina*, *R. damascena*, *R. moschata* (Musk Rose), and others—being more beautiful from an artistic point of view than the Bourbons, Teas, Noisettes, Hybrid China, Hybrid Perpetual, Boursault, Climbing, and other cross-bred or florists' varieties. For an extended account of the species and varieties of Roses, see J. Lindley's *Rosarum monographia*; 'Botanical History of Roses,' with coloured plates; W. Paul's 'Rose Garden' (5th edition); S. Hibberd's 'Amateur's Rose Book;' S. R. Hole's 'A Book about Roses;' and 'Cranston on the Rose.'

Roses are propagated on their own roots by seeds, layers, cuttings, or suckers; and on stocks by grafting in heat from November to February, or budding in the open air in June, July, and August.

The stocks used for Roses are the wild or seedling Brier, *R. canina*; the Italian wild Rose or Manetti, propagated by cuttings of the stem in July, August, and September, and cuttings of the roots at any season. Seedlings raised from cultivated varieties are often more vigorous than their parents, and make excellent stocks. Roots of the wild Brier planted in trenches in the spring throw up clean growth and make excellent stocks for dwarf Roses of all kinds. *Rosa indica* (China), or *R. quatre-saison* of the French nurseries, is largely used as a stock for new varieties, and answers well for grafting in heat. One and a half year old seedling Briers form excellent stocks for dwarf Roses. Mr R. Smith of Worcester propagates 30,000 to 40,000 Tea Roses every season, by grafting them on Manetti stocks in heat. The operation is begun in November, and many of the plants flower in pots the following May. Stocks of the Manetti grown in pots may be splice-grafted throughout the winter and spring (see Grafting). Roots of the Manetti, Dog-rose, or any other variety, may be used as stocks, and worked in heat in the winter or spring. Pieces 4 to 5 inches in length, with a few young fibres, are best, and these can be crown or splice grafted and potted off at once, after which plunge them in cocoa-nut fibre or tan in

a gentle bottom-heat. Gradually harden off the plants when the union is complete, and set the pots out of doors in May or June. An excellent plan is to dig up wild Brier roots in January, and to cut them in 4 to 6 inch lengths, reserving the pieces next the stem or root stock, and throwing the rest away, as these answer best; and roots are plentiful in every wood and hedge. Now cut the scions with two or four buds each, and cleft or wedge graft them on the stem end of the roots, tie firmly with bast, give a coating with cold mastic to guard against damp, and the thing is done. If the roots are thin, never mind—whip or splice graft them. After grafting, plant them in the open ground, so as to just cover the graft, and then cover with three or four inches of sawdust. Try it yourself, and tell it to every one who loves the Rose. See an interesting paper on "Rose Stocks" in 'Jour. Royal Hort. Soc.' (1850), vol. v. p. 70.

Seed.—Some varieties seed freely, some only when artificially fertilised, and some not at all, owing to the suppression or change of their sexual organs. Crossing is performed as in other hermaphrodite flowers, by removing pollen from the stamens, *e*, to the pistil of another flower, *p*. M. Lacharme, a noted Continental raiser of new Roses, grows his seed-bearing Roses trained to a south wall. The first flowering is from 15th April to 13th May, and is no good for seed, for the flowers are very full, little disposed to produce reproductive or sexual organs, and still less adapted for fecundation. It is necessary, therefore, to restrain this first blooming, so as to arrive as soon as possible at the second flowering, which commences at the end of June. This latter blooming is best for fertilisation, the sexual or reproductive organs being better developed, owing to the mere exuberant or vegetative growth having been expended in the first flowers; and the genial dews of summer are a further aid to fecundation. "Some growers," writes M. Lacharme "practise artificial fertilisation, but I have little faith in it. It is necessary that the specimens to be fertilised should be from ten to twenty years old to produce really good new kinds." It may be as well to note that, although M. Lacharme has un



Open flower of Rosa arvensis e, the stamens; p, the pistil

doubtedly raised many good new Roses without having resorted to artificial fertilisation, it does not follow necessarily that this did not actually take place; and one of his best seedlings, "Captain Christy" (Bennett, 1875), is a hybrid Tea—that is, it is a cross between varieties belonging to the Hybrid Perpetual and Tea-scented races. Thin out the flower-buds on the seed-bearing plants, and only allow a few fruits (hips) to ripen, as by this means the seed is better developed and produces a more vigorous progeny. Gather the hips (see figs.) as soon as ripe, and

Hip of Rosa alba, L.

Longitudinal section of the same fr, fruits

sow the seeds at once either in boxes or pans of light sandy soil. The seeds may be placed in a cold pit or frame, or a bed can be formed in a two-light box and the seed sown thinly in rows. When the seedlings are fit to remove, transplant into nursery beds. All new varieties of Roses are not raised from seed, several having originated from bud or branch sports. A rosy pink sport from the buff-tinted Gloire de Dijon has been obtained by Mr A. S. Kemp, and several other instances are known. These are doubtless cases of reversion to one or other of their parents, as it has not been observed to occur except in the case of cross-bred or florists' varieties.

The following varieties of Roses may be relied on as good seed-bearing parents in their respective sections, and pollen from any good flowers may be used to fertilise them:—

Moss Roses.—Alice Leroy, Celina, Marie de Blois.
French Roses.—Glory of France, Napoleon, Perle de Panache.
Hybrid China Roses.—Blairii No. 2, Brennus, Chénédolé, Fulgens, Magna Rosea.
Hybrid Bourbon Roses.—Charles Lawson, Coup d'Hébé, Paul Perras.
Austrian Roses.—Harrisonii.

Ayrshire Roses.—Ruga, Bennet's Seedling.
Damask Perpetual Roses.—Du Roi.
Moss Perpetual Roses.—White.
Hybrid Perpetual Roses.—Annie Wood, Baron Prevost, Centifolia rosea, Charles Lefebvre, Dr Andry, Duc de Rohan, Géant des Batailles, General Jacqueminot, John Hopper, Peter Lawson, Senateur Vaisse, Madame Charles Crapelet.
Bourbon Roses.—Bouquet de Flore, Louis Odier, Sir J. Paxton.
China Roses.—Mrs Bosanquet, Old White.
Tea-scented Roses.—Many varieties seed freely, but most of them require artificial heat to enable them to perfect their seeds well.

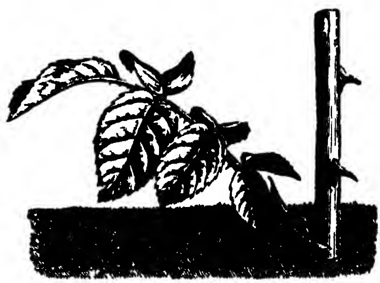
* Comparatively few Roses have been raised in England, owing to an old idea that our climate is not suitable for raising seedlings; but this is a mistake. It may be difficult to obtain perfectly ripe seed from the tender varieties; but this is not wanted, for seedlings from the kinds enumerated above will be far hardier and better suited to our climate and soil in every way than those raised in France under what are often erroneously considered more favourable circumstances. Mr E. Y. Teas, of the Cascade Nursery Co., Richmond, U.S., where Roses are a specialty, in a letter to the 'American Agriculturist,' mentions that in April last he sent Roses by mail to Honolulu, Sandwich Islands, and that they arrived safely, and have since grown well.

Budding.—June is the month generally selected for budding, and in mild, showery weather the buds take best. The operation may be continued through July and August; but in the latter months select dormant buds—that is, such as will not push into growth until the following spring. Buds from the centre or upper part of the shoots are more floriferous than those from the base—that is to say, buds are floriferous in proportion to their proximity to the flowers on the stem from which they were taken. Cut the buds (see Bud-grafting) with a clean, sharp knife, and insert them under the bark of the stock quickly, for much of the success of the operation depends on the inner bark of the stock and scion or bud being placed in close contact when in a fresh and naturally moist state. The bud is then to be bound with coarse cotton, worsted, or bast matting, and will unite with the stock in a fortnight or three weeks, at which time they should be examined, and the ties loosened. In the spring following shorten back the wild shoot or stock, as this induces the bud to push more vigorously; and when the stock has grown a few inches, cut the stock off close to the bud.

Mr W. Paul gives the following instructions on propagating Roses in the 'Florist:' "Grafting is usually done in winter, and

under glass. The Manetti, the Dog-rose, and indeed any common Roses, may be used as stocks. Whip-grafting, wedge-grafting, and crown-grafting seem alike successful, but the first of these is most commonly practised. It is important here that the scion or stranger-wood be of about the same thickness as the stock, so that the inner bark of the scion can be laid exactly upon or in contact with the inner bark of the stock. The two, when placed in contact, should be bound firmly together, as in budding. It is best that the stocks be potted some months before required for use, in order that they may have become established in the pots. The stocks should be placed in a close house or frame, with heat, a fortnight before grafting, that they may be a little in advance of the scion, so as to yield a supply of sap to the scion from the first. When the eyes on the scion have shot an inch or so, the ligature with which it has been bound to the stock may be loosened, and after a time wholly removed. As the plants advance in growth they may be *gradually* brought into contact with the open air."

Cuttings of Roses (see fig.) may be taken and rooted with success in spring, summer, and autumn; and by cuttings we obtain plants on their own roots. Where forcing is resorted to, cuttings may be taken off the plants immediately that the flowering is over, and six or eight of them may be placed round a 48-sized pot, in sandy peat or loam, enriched by a mixture of leaf-mould or decayed manure. They should be set in a close frame or house with bottom-heat, and be kept moist by syringing. They will be rooted and ready for potting-off in about three weeks from the time they are taken. Place them singly in small pots, keeping them in heat until the roots touch the sides of the pots, when they may be gradually hardened and transferred to larger pots. This is the easiest and the quickest way of obtaining Roses on their own roots, but according to my judgment it is not the best way. Stronger and better-constitutioned plants are obtained by taking cuttings from out of doors early in autumn. Select well-ripened shoots, cutting them into lengths of about three inches, and insert them in a sandy soil



Single eye cutting of Rose.

in a shady and sheltered situation, or under hand-glasses out of doors. Here let them remain for a year, when such as grow will have become good-sized, well-rooted plants, ready for removal to any part of the garden."

The following plan for rooting Rose-cuttings has been extensively adopted by Mr Rivers, who thus describes his method. "About the middle to the end of September prepare your cuttings as follows: Take shoots of Roses full of life, and vigorous, with, say, five leaves; remove three of these, and leave two, cutting off the lower part of the cutting near the bud with a sharp knife; then take pots four to five inches in diameter, and fill them to one-fourth their depth with decayed (a year old) cocoa-nut fibre, then place five or six cuttings round the inside of the pot, resting on it the lower ends, thrust through the fibre at the bottom of the pot, then fill up the pot with the same kind of fibre, and press it well down. A piece or two of broken pot should be put at the bottom of each pot for drainage. Their after-management is of great consequence, for on that depends success, or the contrary; nothing can be more simple. Place the pots of cuttings out of doors in full sunshine, unless the autumn is particularly hot and dry; they can then go in the shade for a week or so. They may stand in this exposure till the end of November, or even later if the autumn be mild; and if in October the weather be dry and sunny, they should be sprinkled with water morning and afternoon, so as to keep the leaves fresh and tolerably green. At the end of November or middle of December, if mild (all depending on weather), the pots should be placed in a frame or cool greenhouse, and have plenty of air till they put forth their leaves and roots, when they may be potted or planted out. Formerly, as is well known, the cuttings of Pelargoniums were struck in heat with much trouble and often great loss; they are now propagated after the method I have recommended for Roses with unvarying success. This is my Rose secret, to which the Rose world is most welcome. I may mention that Climbing Roses, Hybrid China Roses, the hardy Tea Roses, the Bourbon Roses, the hardy Noisette Roses, and, above all, the Hybrid Perpetuals, are all amenable to this mode of propagation." Rose-cuttings taken off in summer with a heel of the old wood root freely in damp sphagnum moss, or in bottles of rain-water. Many of the rare old species, such as *R. rugosa* and others, may be readily increased by means of root-cuttings.

A few years ago Mr Shirley Hibberd published a method of raising Roses on their own roots from eyes, which are cut from

the shoots exactly as if for budding, except that more wood is cut with the eyes. The leaves of the bud should be left on, and the buds inserted just below the surface of a well-drained cutting-pan, surfaced with sand (see fig.) Place them in a close shady case, and sprinkle the leaves once or twice a-day with a fine-rosed watering-pot or syringe. They callus and root in about three weeks, and grow away freely, if carefully potted off and placed in a close frame until well established. In the case of new or rare varieties, where a whole shoot cannot be spared as a cutting, this plan is useful and safe.

Bud-cutting of Rose

Layering is a very certain method of obtaining Roses on their own roots. Partially-ripened shoots may be tongued, and laid in the earth or in pots, in sandy soil, about midsummer, and will become sufficiently rooted to be separated and planted out by the autumn or spring, according to the soil, situation, and season.

The following are the types or species from which the more popular sections of garden Roses have originated :—

PROVENCE OR CABBAGE,	(= *R. centifolia*),	Caucusus,	1596.
MOSS, ...	(= *R.* " *muscosa*),	"	
FRENCH, ...	(= *R. gallica*),	Southern Europe,	1596.
HYBRID CHINA, . .	(= *R. indica hybrida*),	China,	1789.
HYBRID BOURBON.—The Roses in this section are hybrids obtained by intercrossing *R. gallica*, *R. centifolia*, and the Bourbon Rose.			
WHITE, ...	(= *Rosa alba*),	Southern Europe,	1597.
DAMASK, . . .	(= *R. damascena*),	Syria,	1573.
AUSTRIAN BRIER, .	(= *R. lutea*), .	Germany,	1596.
DOUBLE YELLOW, .	(= *R. sulphurea*),	Levant,	1629.
SWEET-BRIER, . .	(= *R. rubiginosa*),	Britain.	
SCOTCH, ...	(= *R. spinosissima*),	N. Britain.	

CLIMBING ROSES.

AYRSHIRE, ...	(= *R. arvensis*),	Britain.	
MULTIFLORA, . . .	(= *R. multiflora*),	China,	1822.
EVERGREEN, ...	(= *R. sempervirens*),	S. Europe,	1629.
BOURSAULT, ...	(= *R. alpina*),	S. Europe,	1683.
BANKSIAN, ...	(= *R. Banksiæ*),	China,	1807.
MACARTNEY, ...	(= *R. bracteata*),	China.(?)	
MUSK, ...	(= *R. moschata*),	Bombay,	1596.

Herbert, in alluding to the origin of the florists' varieties or races of cultivated Roses, as long ago as 1837, observes (see 'Herb. Am.,' p. 362): "In the lovely genus Rosa I believe little has been done, except by accident and the necessary consequences of cultivation (see p. 95) and the approximation of species in gardens. The first decided original cross that we know was brought by Fraser from America, where it had been raised between the Musk Cluster and the ever-blowing Chinese, probably by accident, and having been sold to M. Noisette, it has been made to bear his name, and being more fertile in France than in this country, it has become the parent of an extensive family of beautiful varieties. From this plant Mr Smith (of Surbiton) raised by impregnation with the yellowish Indian Rose a variety of some merit, but not a good flowerer under general circumstances; and *Rosa ruga* is understood to have been raised in Italy from the Ayrshire Rose, by the pollen of the Chinese *odorata*, but the fact is not authenticated; and, if I am rightly informed, the great variety of cultivated Roses is owing rather to accidental than artificial admixture."

The Rose has been described by M. Rouillard in the 'Journal de la Société Imperiale et Centrale d'Horticulture,' vii. 480, as one of the most complete and glorious triumphs of the French florists; and, without a doubt, until very recently we have imported all our new Roses from French raisers. The rosarian's heart has been gladdened over and over again by the productions of Descemet, Dupont, Cartier, Ecoffé, Desprez, Hardi, Vibert, Laffay, Verdier, Partemer, Margottin, Fontaine, Ducher, Lacharme, and many others, whose names are familiar wherever Roses are grown. Our own rosarians now, however, have a better opinion of our climate, and raise thousands of seedlings annually. Among those who have been successful in raising Roses in this country we may name Mr W. Paul, Messrs George Paul & Son, Mr Bennet, Messrs Cranston, Mr T. Laxton, Mr Ingram, Messrs J. Veitch, and others. From the 'Garden,' 1876, p. 149, we learn the following interesting details as to the parentage of English-raised Roses:—

"In 1860 a batch of seedlings was in existence at Cheshunt, some the produce of seed obtained by hybridising General Jacqueminot (H.P.) with the Hybrid Chinese Rose of that name. Two were sufficiently good to have been numbered, and proved to be respectively No. 8, Beauty of Waltham (William Paul), and No. 12, Lord Clyde (Paul & Son), sent out respectively by these two firms. The careful watching of the unbloomed seedlings left at Cheshunt proved interesting, and of these some were good, but did not survive. In 1865 Duke

of Edinburgh (H.P.) first flowered, a brilliant crimson Rose of extraordinary beauty, and one of which thousands were sent out in 1868; indeed, the annual sale of this Rose has been the largest of any kind except Gloire de Dijon, General Jacqueminot, and Maréchal Niel. During the hot summer of 1870 Roses ripened seed freely, and amongst others Duke of Edinburgh proved a prolific parent. Some large beds of seed of this and of other leading sorts were sown in the spring of 1871. From these several Duke of Edinburgh seedlings were selected different from their parent, and amongst others Reynolds Hole (H.P.), now a general favourite; Sultan of Zanzibar, a deep crimson variety of good habit; and a very vigorous and very double Rose, which after being tested for five years has proved to be one of the best autumnal varieties yet produced: this was exhibited at Nottingham, under the name of Dr Hooker; and The Shah, a Rose which gained fresh laurels last summer —all these have been deemed worthy of distribution. A third generation of Duke of Edinburgh seedlings from Reynolds Hole are now under trial, and may next season prove interesting. From Madame Victor Verdier has been produced a seedling with thorny wood, which, when shown last summer as Duke of Connaught, was generally admired, representing, as it does, a steady march towards scarlet. Lastly, amongst seedlings raised at Cheshunt comes Tea Cheshunt Hybrid. Besides the beds of seed sown, the contents of a few choice pods were raised in pots, and amongst them a few seeds of Madame de Tartas (Tea), a bush plant of which grew beneath an overhanging roof-trained plant of Prince Camille de Rohan. The result was a singularly vigorous young seedling, showing clear traces in its leaves of its Tea Rose parentage. Without waiting for its flowering two plants of it were budded; they did not bloom the first season, but furnished shoots some 6 ft. long, which repaid the venture the ensuing year by giving two long flower-clad rods of a most distinct Rose, which by 1873 was sufficiently tested to be sent out. It was named Cheshunt Hybrid, a name which denotes both its birthplace and character. It has won for itself a good report, and, owing to its general good qualities, will doubtless have before it, like Gloire de Dijon, a long career. Many other seedlings are under trial, and some, as John Bright, have been favourably noticed. Of Mr Laxton's seedlings intrusted to Messrs Paul & Son's care to distribute, Annie Laxton perhaps holds the first place; like Edouard Morren, it is a seedling from Jules Margottin. In Emily Laxton, to which a certificate was awarded last season, we have one of the most promising Roses in the section to

which it belongs. Prince of Wales (Laxton) is very distinct, but lacks vigour. Princess Louise, a variety obtained purposely for gaining the prize for a white seedling Rose which for some years appeared in the schedule of the York gala, is between Mrs Rivers and Madame Vidot, and is, singularly enough, one of the freest-flowering true hybrid perpetual Roses we possess. It may not be out of place to state that M. Lacharme, starting with the white hybrid perpetual Louise Darzens, has gone on bringing forward an increasingly beautiful series of white hybrid perpetual Roses, among which may be named Boule de Neige and Perle des Blanches. M. Guillot Père has also followed a strain in the same way, beginning with Victor Verdier, Comtesse d'Oxford, and others of similar character."

The beautiful climbing Devoniensis was raised by Mr George Foster of Oatland, Devonport, and is a seedling from Yellow China, fertilised with pollen from Yellow Noisette Elinthii. Mr Pince gave fifty guineas for it, and sent it out by the thousand, and even now it is one of the best of all climbing Roses.

Rubus (*Raspberries* and *Blackberries*).—A well-known genus of, for the most part, hardy plants, natives of Europe and America. The British Rubi are well known to botanists, and owing to natural cross-breeding, the forms of these are so variable and numerous that it is next to impossible to define species with certainty. The Raspberry (*R. idæus*) and the Blackberry (*R. fruticosus*) are the most useful for their fruits, and numerous improved or selected seedling forms of the latter are largely grown in America, and are well worth culture in our gardens here at home. Some of the ornamental species are very beautiful. *R. biflorus*, or whitewashed Bramble, is very distinct, its stems being white; hence its popular name. It bears yellow Raspberry-like fruits of tolerably good flavour. Raspberries are readily multiplied by division; and it is curious as an example of a herbaceous shrub, if one may be allowed the term, its woody stems dying down annually. Seeds germinate readily, and should be sown as soon as ripe. Blackberries root freely from layers; indeed the points of the shoots naturally take root wherever they touch the earth. Both Raspberries and Blackberries may be increased readily by root-cuttings. Dig up the plants to be propagated late in autumn, with all the roots that can be secured. Cut the roots into pieces about two inches long, and place them in alternate layers with sand or fine moss in a box. Place the box in a cool cellar to prevent growth; keep the sand or moss moderately damp. Early in spring the cuttings will have well-developed buds. Plant them out in drills

in rich ground two inches deep. If well cultivated, they will make good plants by autumn.

An interesting account of cross-bred and seedling Raspberries, accidentally raised by Mr Thomas Rivers between the "Black Raspberry" and the Ohio Raspberry, which is a seedling variety of the Blackcap (*Rubus occidentalis*), is given in the 'Gardeners' Chronicle,' 1867, p. 516, 517. From selected seed of these cross-breds, hundreds of plants were raised, and these, besides varying much in habit and vigour, bore red summer Raspberries; red, pink, flesh-coloured, and white autumnal sorts; and yellow summer and autumnal varieties, and small-berried black autumn Raspberries of enormous growth.

In the 'London Journal of Botany,' 1873, p. 108, is a very interesting paper on the origin of *Rubus idæus* or common Raspberry, by M. F. W. C. Areschoug. This botanist states his reasons for believing that this plant has descended from some simple-leaved species, native of Japan, which has spread eastward over North America, and thence to Europe. From the same paper we learn that *R. pseudo-cæsius* and *R. pseudo-idæus* are real hybrids, produced between *R. idæus* and *R. cæsius*. Mr J. Anderson-Henry has raised hybrids between *R. biflorus* and *R. idæus*, the last-named being the seed-parent, but the seeds so obtained failed to vegetate (see p. 165).

One of the most handsome ornamental-flowering species is *R. odoratus*, which grows 3—4 feet in height, and bears large, bright, pink, Rose-like flowers among its deep trilobed leaves. It was brought from North America in 1739 (see 'Bot. Mag.,' t. 323).

Rubus arcticus, or Dwarf Bramble, is a charming little creeping Alpine shrub, found in Europe and North America. It has ternate leaves, bright rosy flowers, the size of a silver sixpence, and is little over a foot in height. Its fruit is used in jellies and conserves in Sweden, and is said to be delicious (see 'Bot. Mag.,' t. 132).

Spiræa.—A well-known genus of herbaceous plants and shrubs, principally natives of the temperate parts of the world, some of the most beautiful species coming from China, Japan, North India; two species—*S. ulmaria*, or "Meadow-sweet," and *S. filipendula*, or "Dropwort"—are natives of this country. *S. palmata*, *S. japonica*, *S. venusta*, *S. aruncus*, and others, are well-known perennial herbaceous species; while *S. Fortunei*, *S. prunifolia*, *S. bella*, *S. tomentosa*, *S. Lindleyana*, and others, are beautiful shrubby kinds. The first-named group may be propagated by seeds sown in pans in a cool frame, or by careful division in the autumn or spring. Herbaceous cuttings of the

shrubby species root tolerably well in a close case, and layers are also successful.

Spiræa (Exocorda) grandiflora is a handsome shrubby species, rather difficult to propagate even from herbaceous cuttings. The readiest way to multiply this species is to graft cuttings of the partially-hardened wood on thick pieces of its own roots, just as is commonly done in the case of Wisterias, Tecomas, Petræa, Ipomæas, Dammaras, Keteleeria Fortunei, and many other rare and beautiful shrubs or trees from which fertile seeds are not procurable for the time being. Grafting is best performed in a close frame or case in a genial temperature of about 60°. If this method is adopted we may soon hope to see this beautiful plant, and many other of the shrubby Spiræas, more plentiful in our gardens.

Many hybrid varieties of Spiræa have been raised by Mr Willison of Whitby, *S. palmata* being used as the seed-bearing plant, crossed with *S. japonica*. Most of these hybrid plants have pinnate leaves, and white, pink, flesh-coloured, or rosy-tinted flowers.

THE CLEMATIS, PEONY, AND ANEMONE FAMILY (*Ranunculaceæ*).

A well-known and widely-distributed natural order of plants, found in most temperate countries, and represented in our gardens by many beautiful species and varieties of Anemone, Clematis, Ranunculus, Hepatica, Trollius, Hellebore, Aquilegia, Delphinium, and Peony; and in our fields and ditches by "Buttercups" or wild species of Ranunculus. The flowers generally in this family resemble the flowers of some species of Rosaceæ in form, and in having numerous stamens and clustered fruits, something like those of Blackberries ere they become ripe and succulent. The number of the carpels varies considerably, from one to three as in the Peony, to twenty or thirty as in the case of Ranunculus. All the species are easily fertilised artificially, although, from the excessive number of stamens, some little care and skill must be exercised in emasculating the female or seed-bearing flower. The artificial improvements made in this order are numerous—beautiful forms of Clematis, Peony, Delphinium, Anemone, Hellebore, Ranunculus, and Hepatica—but a vast field is still open to the intelligent hybridiser, who may, by blending the forms already accidentally, culturally, or designedly obtained, with pure and distinct species of their respective or other closely-related genera, fix new and

beautiful races of some of our most popular and useful hardy and half-hardy flowers. It may be well to bear in mind that nearly all the plants in this order are acrid, and often dangerously poisonous, especially Aconites, Hellebores, &c.

Aconitum (*Monk's-hood*).—A genus of Ranunculaceous plants, natives of Europe, North America, and North Asia, and represented in cultivation by *A. napellus*, a poisonous species, its roots having on many occasions been mistaken for those of Horse-radish. *A. ferox* is used in North India as a poison for arrows—the poison, which is obtained from the roots, being of remarkable virulence and activity when infused into the blood. Readily multiplied from seed or by division.

Anemone.—A very attractive group of hardy, tuberous-rooted, herbaceous plants, natives of southern and temperate Europe, America, North India, and Japan. One species, *A. nemorosa*, "Wood Anemone," is native, and might possibly be much improved by crossing it with some of the more showy kinds from the Mediterranean region. All are readily propagated by careful division of the roots or tubers in the autumn, replanting them in a nursery bed or border in a rich, sandy, and well-drained soil. *A. japonica* and its varieties may be quickly increased to almost any extent by root-cuttings planted in light sandy soil, and placed in a close cool frame, or on a very slight bottom-heat not above 60°. Possibly *A. vitifolia* and other allied species may also be increased in this manner, and certainly this remark applies to all the tuberous-rooted kinds, such as *A. blanda*, *A. alpina*, *A. fulgens*, *A. coronaria*, and others. The florists' Anemones are varieties of *A. coronaria* and *A. stellata* (*A. hortensis*) (see 'Bot. Mag.,' t. 123). *A. narcissiflora* is a very chaste white-flowered species; and *A. japonica*, with its seminal varieties or "sports," is a very noble hardy plant. *A. blanda* and *A. apennina* are beautiful spring-blooming kinds, bearing light-blue flowers, both easily propagated by cutting up the fleshy tubers. By crossing the spring-flowering kinds with the autumn bloomers, an intermediate race might possibly be obtained. New florists' varieties are readily obtained by saving seeds from a bed of good sorts, which should be sown as soon as ripe in a cold pit or frame; or they may be sown in a warm, sheltered, sandy border, and allowed to remain until they bloom.

Mr Gordon raised numerous hybrid Anemones twenty or thirty years ago in the Chiswick garden between *A. japonica* and the Himalayan *A. vitifolia*, which were crossed reciprocally; and while some beautiful seedlings resulted from the union when *A. japonica* was made the female or seed-bearing

parent, the reverse was the case when pollen from *A. japonica* was used to fertilise *A. vitifolia.*

The Hepaticas are referred to the last-named genus, and are very beautiful spring-flowering plants. *H. triloba* is the plant so often met with in cottage gardens, and its seminal varieties are white, rose-coloured, blue, lilac, or purple. These plants are dwarf and very profuse bloomers, and might perhaps be yet further improved by crossing the single-flowered varieties with some of the larger-flowered spring-blooming Anemones. *H. angulosa* is the only other species, and of this there are only two varieties, differing mainly in the size of their flowers, which are of a delicate lilac colour. They are readily propagated either by division or by seed, as in Anemone.

Aquilegia (*Columbines*).—A genus of American, European, or Asiatic plants of elegant habit, bearing blue and white, purple, scarlet, or yellow flowers. *A. vulgaris* is variable in colour (as, indeed, are nearly all the species), and is a native of this country. *A. aurea*, an American plant, bears showy, long-spurred, yellow flowers. *A. glandulosa* is one of the finest, having large blue and white flowers, this having been introduced from Siberia in 1822. Most of the species are natives of Siberia and the Altaian Mountains. They are readily propagated either by division or by seed, which is freely produced. *A. canadensis* is distinct, bearing scarlet and yellow flowers; and this might give a permanent race if crossed with *M. blanda*, *M. glandulosa*, or some of the finest seminal forms of *A. vulgaris.* These flowers are quite hardy, and so distinct in form that one would like to see them further improved, either by seminal variation and selection or by carefully hybridising the finest species and varieties. Even in a state of nature these plants vary much in the size and colour of their flowers, and it is probable that there are but few true species among them. *Aquilegia hybrida* is a party-coloured seminal form, said to have accidentally originated in considerable quantities among seedlings of *A. canadensis*, and may possibly be a hybrid between the last-named species and *A. vulgaris.* The colour of its flowers is purple and white, with bluish spurs. M. Lemaire mentions a case in which a seedling plant, very nearly resembling *A. blanda*, was produced in the garden of M. Verschaffelt, presumably by the accidental intercrossing of *A. leptoceras* with a variety of *A. vulgaris.* Seed should be sown on a warm sunny border in autumn or as soon as ripe. Sow thinly, so that the young plants do not overcrowd each other, and most of them will then flower either the first or second season. Gaertner remarks that the seeds obtainable by fertilising *A. atropurpurea*

with *A. canadensis*, *A. vulgaris*, and *A. glandulosa*, are of variable degrees of perfection and number.

Clematis.—A very graceful group of climbing, herbaceous, or shrubby flowering plants, which, thanks to the intelligence and perseverance of hybridisers, bids fair to become one of the most popular in our gardens. The species are found throughout Europe, and a few are indigenous to America, China, and New Zealand, while a few more are tropical. The herbaceous section may be propagated by careful division in the spring, just before they commence to grow, or herbaceous cuttings may be rooted with care on a gentle bottom-heat protected from drought by a bell-glass or *cloche*. The shrubby kinds may be propagated very readily by herbaceous cuttings made in heat, or the short laterals may be taken off and rooted under a *cloche* after the base has commenced to harden. Examine the roots very carefully, and if you can cut off an eye with the least bit of root attached to it, put it into heat, and by next autumn you will have a capital plant for outdoor planting. All the *Jackmannii* section will easily multiply in this way. The scandent or climbing kinds are propagated from layers of the current year's shoots in autumn, or by grafting on the roots of the commoner kinds. The roots should be introduced into a heated case a few days before they are required for use, so as to vivify them, as these should always be in a more quickened state than the scions to insure a maximum amount of success. The operation is best performed in May; but clever operators do not much mind at what season they propagate in this way. Scions should be formed of the current year's growth, taking care to leave three or four leaves upon them. Clean pieces of root, three or four inches in length, are best, with plenty of fresh, young, growing fibres at the end. Cleft or splice grafting are alike successful, taking care to make clean cuts, after which tie carefully, anoint with liquid wax or cold mastic, and pot in light rich earth, and then place the pots and grafts in a close case on a gentle bottom-heat. After the grafts have taken, gradually harden off. The common blue Spanish Clematis forms good stocks, and these are generally attainable in most gardens. Where seedlings are grown, these, if found to be worthless as new varieties, may either be grafted or inarched with good known varieties. Seed may be readily obtained by carefully crossing varieties, or varieties with species, in which way some striking results might doubtless be obtained. The *Clematis* is easily propagated by saving seed from the best of the new hybrids, some of which produce fertile seeds very freely. The following are good seed-parents: *C.* "Albert

Victor," "Lady Londesborough," "Mrs J. Bateman," "Lord Londesborough," "Miss Bateman," *Standishii*, *azurea grandiflora*, *Jackmannii*, *viticella*, *lanuginosa*, and others. Seeds sown in autumn as soon as ripe, in a warm pit on a slight bottom-heat, germinate the following spring. Seedlings flower the first or second year from seed. Gather the seed as soon as ripe in autumn, and either sow at once or keep it in a dry place until the spring. Sowing as soon as the seed is ripe is a good practice; and for this purpose shallow boxes or pans of moist sandy earth are best. Sow thinly on the surface, and cover very lightly with fine soil, after which place the seed-pans in a warm pit or stove until the seeds vegetate, after which use great care in watering, and place them in a dry, airy, and sunny position near the glass. The seedlings may be potted as soon as fit to handle, and grown on to the flowering stage as quickly as possible. If any variety turns out to be a decided improvement, grafting is the best and quickest way of multiplication. A glance at what has been effected in this genus will be interesting to the cultivator or hybridiser, and also enable him to avoid doing work that has been done before. One of the oldest of all known hybrid Clematis is *C. Hendersonii*, which is presumably the result of a cross effected in 1835 between the Spanish *C. viticella* and the Hungarian *C. integrifolia*. The Japanese species appear to have varied very much in their native country under cultivation; but whether this had been brought about by culture, seminal reproduction and selection, or hybridisation, we cannot say; yet we know that M. von Siebold, the Japanese traveller, introduced several beautiful forms of *C. patens*, a plant also known as *C. cærulea* or *C. azurea* in books and gardens. In 1850 a seminal variety was raised by M. Tulon of Libourne, this being recorded in the 'Flore des Serres' for the same year. One of the first hybridisers in this country who set out with a definite and intelligent object was Mr J. Anderson-Henry, who, in 1855, crossed *C. patens* (*azurea grandiflora*) with *C. lanuginosa*, a large and beautiful blue-flowered Japanese plant, the result being a large lavender-flowered variety named *C. regina*. Messrs Jackman & Sons, of the Woking Nurseries, set to work, in 1858, by crossing *C. lanuginosa* with *C. Hendersonii* and *C. viticella atrorubens*, the result being the production of *C. Jackmannii* and *C. rubro-violacea*, exhibited in 1863, as being two of the most distinct hybrids. A large number of varieties, however, resulted from the first sowing, and among others the following: *C. viticella pallida*, *C. viticella Mooreana*, *C. viticella amethystina*, *C.* Prince of Wales, *C. rubella*, *C. magnifica*, *C.* Alexandra, and

C. velutina purpurea. A second batch of seed obtained by crossing *C. lanuginosa* with some of the darkest-coloured of the above hybrids produced the following remarkable variable kinds: *C.* Mrs J. Bateman, *C.* Beauty of Surrey, *C.* Lady Bovill, all greyish blues, the latter peculiarly cup-shaped, together with *C.* Sir R. Napier, a rich purple, and *C.* Thomas Moore, in which the purple sepals were enriched in tone by the long white stamens. A Mr Townshend, propagator to Messrs Jackman until 1862, went to live at Hornsey, and he sowed previously-hybridised seed soon after Christmas 1862, some of which bloomed in 1863, and some the year following. The following were exhibited in July 1864 at Regent's Park: *C. lanuginosa violacea*, dark purple; *C. lanuginosa atropurpurea*, dark violet; *C. lanuginosa Hollandii*, violet, with a reddish bar. Next year the following were exhibited: *C.* Miss Braddon, lilac-purple, pale bar; *C.* Aurora Floyd, violet, pale-whitish bar; *C.* Lady Audley's Secret, lavender; *C.* Souvenir de Cardinal Wiseman, reddish, pale stripe; and *C.* Rev. Canon Oakley, pale lavender-purple. All Mr Townshend's varieties seem to have gone out of cultivation. MM. Simon-Louis, of Metz, claim to have been the first in the field in improving the Japanese Clematis; but Mr Henderson, then of the Pine-Apple Nursery, Mr Anderson-Henry, Edinburgh, and Messrs Jackman, had raised hybrids prior to 1861, the date at which they claim to have obtained their hybrid *C. splendidula.* These zealous raisers originated many fine seminal varieties, as well as hybrids. *C. splendidula* was the result of a cross between *C. lanuginosa* and *C. viticella grandiflora*, and was sent out in 1863. *C. fulgens*, a seedling from the same parents, appeared in 1865, and *C. perfecta* in 1867—the first a narrow-sepalled red flower, the last a white variety.

One of the earliest of Continental hybridists who raised new large-flowered Clematis was M. Briolay-Goiffon of Orleans, who in 1860 obtained *C. aureliana*, a well-formed porcelain-blue variety, by crossing *C. lanuginosa* and *C. patens.* This was sent out in 1865. Another Continental raiser, M. Rinz of Frankfort, originated *C. Francofurtensis;* M. Lemoine of Nancy, *C. lanuginosa candida*, *C. lanuginosa nivea*, *C.* Otto Frœbel, and, of a more recent date, *C.* Lucie Lemoine, a double-flowered form of the *C. Fortunei* and *C.* J. Gould Veitch type. M. Carré of Troyes sent out, among others, *C.* Gloire de St Julien and *C.* Impératrice Eugénie; and M. Dauvesse of Orleans sent out *C.* Jeanne d'Arc, and *C. Renaultii cærulea grandiflora.* M. Modeste Querin originated *C. Modesta* and *C. purpurea hybrida*, both belonging to the *C. Jackmanii* and *C.*

viticella race. *C. intermedia rosea* and *C. diversifolia cærulea*, both belonging to the shrubby section, were raised by MM. Bonamy Frères; and M. Lemoine raised *C. erecta*, a double-flowered form of the herbaceous group. Messrs Cripps & Sons of Tunbridge Wells have raised many very large-flowered and valuable varieties from *C. lanuginosa*, among which we may note *C.* Lady Caroline Neville (1866), *C.* Mary Lefebvre, and *C.* Madame Van Houtte (1867); and numerous fine varieties of a more recent date, including *C. tunbridgensis*, *C.* Star of India, and others. Mr Noble of Sunnydale, Bagshot, has originated some fine forms by crossing *C. Standishii* and *C. lanuginosa*, the parents of *C.* Gem, which in size, form, and colour of flower closely resembles Mr Anderson-Henry's *C. reginæ* (*C. lanuginosa* × *C. patens*). Mr Noble's hybrids were raised from *C. Standishii*, *C. Fortunei*, and *C.* Sophia, with *C. lanuginosa;* the two latter being the seed-bearing parents, and the result is a sturdy and hardy race, bearing large richly-coloured flowers.

Some of Mr Anderson-Henry's more recent seedlings are of marvellous size and substance, especially *C. Lawsoniana*, *C. Henryi*, and *C. Symesiana*, which, the raiser says himself, "belong to the *lanuginosa* type, *Clematis lanuginosa* being the seed-bearer, and *C. Fortunei* the male parent. Some of the seedlings, also in Messrs Lawson's hands, flower early; but others, to which group those announced and which are mentioned above belong, do not bloom before August, and go on till November or later. In fact, I have them under glass flowering now (January 18).

"As to size, they average from 4 or 5 to 8 or 9 inches in diameter, but this last size is the extreme: a bloom of *C. Lawsoniana*, a large-flowered variety, has indeed attained 9½ inches.

"As to the colour of the flowers, there is something to me wholly inexplicable in all this *lanuginosa-Fortunei* brood; for while the seed-bearer, *C. lanuginosa*, has pale-lilac flowers, and *C. Fortunei*, the male parent, has pure white semi-double blossoms, those of some of their progeny deepen into blue or azure, banded sometimes with darker shades, in which a tint of rose comes up. How they should have any shade of blue at all, and still more how they should have darker-shaded bands, is utterly unaccountable to me from all the experience I have had, unless I should be right in an assumption which has been forced upon me,—namely, that *C. Fortunei* is a white-flowered seedling variety of a blue-flowered species—perhaps of *C.* John Gould Veitch—these being, so far as I can remember, much alike in their general habit, foliage, and inflorescence, even to

the semi-double flowers which both possess. The latter is, no doubt, the more vigorous in growth,* and it has its flowers larger and more double than those of *C. Fortunei*—consequences, natural enough, if I am right in this assumption: just as occurred in the white-flowered seedling sport from the lovely blue-flowered *Salvia patens*, which never had the vigour of the original form. My theory is, that the sport will sometimes retrogress. I had proof of this in that same white *Salvia*, the seeds of which I sowed, when the seedlings went back into the species, but had flowers of a paler blue. In this way I think I can account for many of those varieties already put out, derived, I assume, from much the same parentage as mine, having the size, colouring, and banding all so different from their parents; for in all my efforts with this tribe—and I began with it, I believe, first in this country, the seeds of my hybrid, *C. reginæ* (*C. azurea grandiflora* × *C. lanuginosa*) having been sown in 1855, long before *C. Jackmannii*, the next, I think, in order, was heard of—in all these efforts, and I have been working on it ever since, I could reckon with some confidence as to the colours to be produced by crossing, till in this last case I felt bewildered. Now it is very notable that though a white-flowered sport may go back in its seedlings to its original blue-flowered species, the white may be fixed, or, at least, reproduced in the offspring. Hence I have from seeds of the same head not only the blue and azure flowered varieties above noticed, but the pure white or creamy-white *C. Henryi*, and others not yet announced.

"As to the number of the sepals, these vary even in the same group. In that just noticed (*lanuginosa-Fortunei*), there are generally six to eight in each flower. To my taste these should stand out straight from the disc, neither incurving nor reflexing."

A purple variety of *Clematis flammula*, which it is proposed to distinguish by the name of *C. flammula roseo-purpurea*, has been raised by Mr G. Jackman. Several plants have been observed in a bed of transplanted seedlings of the sweet-scented Clematis, which had been raised from seeds ripened in contiguity to plants of some of the purple-flowered forms of *C. viticella*. The novelty has, indeed, quite the appearance of being an accidental hybrid between *C. flammula* and *C. viticella*, though in regard to free vigorous habit of growth, abundance of flowering, and strongly-marked Hawthorn-like fragrance, it

* Every cultivator of the Clematis should see Moore and Jackman's 'The Clematis as a Garden Flower,' from which many of the above historical remarks have been gleaned.

partakes most strongly of its mother-parent, flowering also at the same season—from the middle of July onwards. This will be a fine acquisition amongst hardy climbers, and will be welcomed not only for its well-marked purple colour, but also for its delicious perfume. It is quite unlike the fragrant *C. cærulea odorata* both in habit and flowers, being a true Flammula in its growth and leafage.

A dwarf variety of *Clematis viticella*, named *nana*, was raised at the Paris Museum. Its flowers resemble those of the species, but are larger, and of a rosy lilac. The plant is only from 16 to 20 inches high, and is not only very floriferous, but perpetual-blooming. In fact, its shoots as they are developed are terminated by flowers, in such a manner that the plant is almost constantly provided with them. This dwarf *C. viticella*, observes M. Carrière, shows us how new characters appear—consequently how species are formed. Proceeding from a climbing plant which flowers but once, this is dwarf and not climbing, and its flowers are brought forth in succession during the summer.

C. viticella, var. *venosa*, is a hybrid variety which originated in French gardens, and is interesting as an illustration of that sudden development of certain unsuspected characteristics, of which Mr Meehan and others have given examples. This plant was grown in French gardens for twenty years, and during all that time was never known to bear seeds, when all at once one plant out of several bore a copious supply of fertile seeds, the other individuals remaining barren as heretofore. This singular fact should teach us to hesitate before pronouncing any hybrid or seminal variety to be sterile (see 'Revue Hort.')

In the 'Gardeners' Chronicle,' 1844, p. 587, the advisability of crossing the different species of Clematis is pointed out by Professor Lindley, from whom in all probability some of the earlier hybridisers of this genus took the hint. In the article cited, this distinguished philosopher says: "Clematis will cross most readily in the following order—1. *C. Flammula*, *vitalba*, and *cylindrica*; 2. *C. florida*, *azurea*, *viticella*, *balearica*, and *montana*; but there is no apparent reason why they should not all also intermix in skilful and patient hands."

There is yet an ample field, not only in improving the cross-bred forms now known, but especially in originating new races. The following species, among others, are worth improving: *C. calycina*—this plant was introduced to our gardens in 1783 (see 'Bot. Mag.,' t. 959), and bears four-sepalled, creamy-white flowers, spotted with purple, among elegantly-divided leaves.

C. montana is a very beautiful hardy plant, bearing white flowers very profusely, and it can be forced readily, grown in pots. *C. cirrhosa.*—This is a Spanish winter-blooming plant, quite hardy, and has been cultivated since 1596. It has pretty creamy-white or pale-yellow flowers, borne in axillary clusters among the ovate, serrate, evergreen leaves (see 'Bot. Mag.,' t. 1070). At Glasnevin this plant flowers in the open air from November until February, hence it ought to be invaluable to the hybridiser. *C. integrifolia* is a distinct species from Germany, with four-sepalled flowers of a deep-blue colour. It would be most useful for hybridising with other allied species, or crossing with modern varieties (see 'Bot. Mag.,' t. 65).

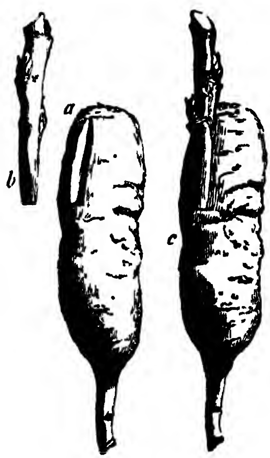
Delphinium* (*Larkspurs*).—A showy genus of hardy annual or herbaceous plants, principally natives of America, Southern Europe, and Northern Asia. They are represented in our gardens by *D. grandiflorum*, a large-flowered, deep-blue-flowered plant introduced from Siberia in 1816. Of this there are several rosy, white, purple, and double-flowered forms. *D. chinense*, also blue, introduced from China in 1818. *D. sibericum*, and others from which our modern varieties have originated. *D. consolidum* is a native of England. The annual species are readily propagated from seeds sown in March, while the herbaceous kinds may be propagated from division of the roots, or by autumn-sown seeds. All the herbaceous varieties are readily propagated from cuttings during the spring and summer months, and this method may be adopted to increase desirable seedlings. Numerous beautiful hybrids and seminal varieties have been raised in gardens, and few blue-flowered plants are more stately or useful for early summer blooming. *D. ambiguum* is said to be a hybrid between *D. elatum* and *Aconitum napellus*. *Delphinium formosum* is a garden hybrid, although it reproduces itself from seed as truly as most species. It was raised by the late Mr C. Moore, nurseryman, East Dereham, Norfolk. *D. nudicaule*, a rather weakly-habited plant, bearing red or scarlet flowers, might be used for hybridising some of the robust-habited varieties, such as *D. formosum*, *D. belladonna*, the last being one of the most lovely of all blue-flowered plants. Numerous double-flowered varieties have been raised in Continental gardens, *D. Keteleerii* (see 'Florist,' 1874, p. 73) being one of the best. Mr Thomas Ware of Tottenham has also raised numerous improved forms, and these form fine pot-plants for

* See Parkinson's 'Paradisus in Sole,' p. 277-279, for figures and descriptions of old kinds.

exhibition in the spring and summer months. *D. ajacis*, a Swiss plant introduced in 1573, bears pink flowers, and is one of the parents of the annual section of "Larkspurs." *D. cashmirianum* is a new Indian species, bearing large purplish-blue flowers, and this plant is well worth the attention of hybridisers.

Helleborus.—A genus of ornamental plants, principally of temperate Europe and Asia. One of the best-known plants in our gardens is *H. niger* or "Christmas Rose," which has glossy digitate foliage and either white or pale rose-coloured flowers. There are several seminal varieties in cultivation, and by crossing these with some of the hybrids already obtained in Continental gardens, a more beautiful and more highly serviceable coloured race would doubtless result. As a winter-blooming plant, the above-named species is very useful, as it can be grown without any attention except a hand-light placed over it to prevent its delicate flowers becoming splashed by heavy rains. All the species are readily multiplied by dividing the fleshy roots in the autumn or spring. The common *H. niger* and its varieties, including *H. niger maximus*, are easily propagated by cuttings of the root taken off in July or August, and inserted either in pans of rich earth in a cool frame or in open-air beds. Hellebore-seeds grow so freely when sown in the open ground, and are so freely produced, that Mr H. N. Ellacombe says, "I never attempt to grow Hellebores from seed, but I have often hundreds of self-sown seedlings of different sorts." Many beautiful hybrid Hellebores have been raised in the Berlin Botanic Garden by M. Sauer, the late curator. These were the result of a cross effected between *H. guttatus*, Braun, which grows near Tiflis on the southern slopes of the Caucasus, and *H. purpurascens*, a Hungarian species. Two forms of this are found on the western Caucasus, the darkest-coloured variety being called *H. colchicus* by Dr Regel, and the paler one is known in Continental gardens as *H. abchasicus*, and was the one used in crossing with *H. guttatus*. The result was a series of rosy, white, purple, brown, or creamy flowers, all more or less spotted or streaked with carmine, red, or deep purple. Seed was saved from both parents, and flowered four to five years after it was sown. M. Sauer improved his seedlings by selection, and sowed seeds from the finest of the first batch, which produced still more handsome flowers, and some of these were afterwards crossed with *H. officinalis* by M. Bouché. M. Heinmann of Erfurt has also raised beautiful new hybrids from the first-named parents (see 'Gard. Chron.,' 1874, i. 118-480, 'Florist,' 1875, p. 161).

Pæonia * (*Peony*).—A very beautiful group of large-growing hardy shrubs or herbaceous plants, the latter natives of Europe, while the shrubby or "tree" Peonies (*P. moutan*), as they are popularly called, were first introduced from China in 1789. Numerous varieties are grown by the Chinese and Japanese gardeners, it having been one of their favourite flowers, together with the Chrysanthemum, for ages. The varieties of the herbaceous section seem to have originated from *P. albiflora*, a very variable plant, introduced from Siberia in 1548, and *P. officinalis*, also a variable European species, introduced at the same time. *P. tenuifolia* has very finely cut leaves and rich red flowers, and was introduced from Siberia in 1765. It seems a pity that the numerous noble-habited, bright-coloured, and deliciously-perfumed varieties of *P. moutan* should be so little grown in our gardens, as with a little protection during the winter and spring they form noble bushes on the lawn or pleasure-grounds. All the herbaceous species and varieties are readily propagated by careful division in the autumn or early spring, or from seed. The Chinese tree varieties may be propagated by layering, ringing, or girdling the stem below each node or bud, so as to facilitate the production of roots. Cuttings root freely in bottom-heat in the spring, or young shoots may be grafted on herbaceous roots in the spring or summer, in a close case or frame (see engraving). It is a mistaken idea that grafting is absolutely necessary, and one that has prevented many amateurs from propagating their own plants. New varieties may be raised from seeds of the semi-double-flowered kinds, which should be sown in autumn as soon as ripe, or in early spring, in boxes of light rich earth placed on a gentle bottom-heat until they germinate, after which a greenhouse temperature and light airy position near the glass is best. It would be interesting to raise hybrids



Root-grafting the Tree Peony. a, scion; b, stock; c, the same ready for tying.

* See Parkinson's 'Paradisus in Sole,' p. 341, and figures on p. 343, of kinds grown in old English gardens in 1629; and 'Trans. Linn. Soc.,' xii. 248, for a monograph of the species.

between the European and Chinese varieties, and a hardier race of the latter might possibly be originated in this way. *P. moutan* and its innumerable rosy, white, pink, fawn, and blush varieties are so lovely and fragrant that we have few spring-blooming plants which can compete with them for conservatory decoration, and they force very readily. Numerous seedlings have been originated in Continental gardens, and as a decorative plant we feel sure this might be so improved as to be second only in beauty and fragrance to the Rose itself. The three first plants introduced to European gardens were *P. moutan*, *P. papaveracea* or poppy-flowered, and a rose-scented variety *P.* (*moschata*) *rosea*. M. Verschaffelt was one of the first to hybridise these flowers, his "Alexander II." being the result of a cross between *P. papaveracea* and *P. rosea*. M. van Gert also, a Belgian florist, originated several fine forms, one of the best being "Triomphe de Gand." "According to M. Lecoq, the varieties of the "herbaceous" section originated from *P.* (*edulis*) *fragrans*, *P. albiflora*, and *P. sinensis*. M. Lemon commenced to hybridise these plants so long ago as 1828, and obtained numerous fine forms, and after his death the work was continued by M. Lemon fils, M. Jaques, and M. Guérin-Modeste. The following lists of the best varieties in each section will be useful to planters and hybridisers:—

TREE PEONIES (*P. moutan*).

Alba grandiflora.
—— lilacina.
—— plena.
Arborea.
Atropurpurea.
Beauty of Canton.
Candidissima.
Carnea pleno.
Dalacheii.
Doncklaarii.
Dr Bowring.
Elizabeth.
Emperor of China.
Glory of Shanghai.
Grand Duc de Bade.
Jewel of Chusan.
Lactea.
Lilacina.
Madame de Vatry.
Moutan.
Ocellatum.
Osiris.
Parmentierii.
Papaveracea.
—— fiore alba-pleno.
—— rubra-pleno.
Phœnicia flore-pleno.
Purpurea.
—— violacea.
Robert Fortune.
Rollissonii.
Rosa mundi.
Rosæformis.
Rosea.
Samarang.
Triomphe de Vandermaele.
—— des Flandres.
—— Gand.
—— Malines.
Unicolor purpurea.
Versicolor plena.
Victoria.
—— alba.
Violacea purpurea.
—— plena.
Zenobia.

HERBACEOUS PEONIES.

(*P. edulis, P. albiflora, P. sinensis, P. officinalis.*)

Alba superba—white and pink.
Anemoneflora carneo-tincta—rosy white.
Atrosanguinea—crimson purple.
Auguste van Gert—rosy purple and white.
Candidissima — white or straw colour.
Carnea maxima—flesh-pink.
Centifolia rosea—rose and white.
Duc de Cazes—rosy purple.
Eugène Verdier—rosy pink.
Jeanne d'Arc—pink and white.
Léoni—flesh-pink and white.
Lilacina—bright rosy lilac.
Madame Calot—rosy purple and white.
Madame Margottin — rosy pink, marked with purple.
Madonna—deep rose.
Mrs Hartnell—rose-pink.
Prince Charles—rosy purple.
Pulcherrima—French white.
Purpurea—crimson purple.
The Queen—creamy white.
Tricolor plena — rose-pink and white.

Peonies are very variable plants even in their wild habitats, and the original state of *P. moutan* is unknown. The last-named plant is the parent of numerous lovely forms, and has been assiduously cultivated by Chinese gardeners during the last fourteen centuries. It is said to be a native of the mountains of Northern China. The following are some of the early forms grown in our gardens :—

Pæonia anomala.—A cut-leaved plant from Siberia, bearing bell-shaped, bright, rosy flowers. Like *P. tenuifolia*, it is of elegant habit, and might be useful in cross-breeding. (See 'Bot. Mag.,' t. 1754.)

P. albiflora, introduced in 1784, has white flowers, and appears to be a very variable plant. Its flowers are very fragrant. (See 'Bot. Mag.,' t. 1756.)

P. edulis, var. *sinensis.* — A showy, double-flowered, rosy, crimson-flowered plant, very fragrant, and supposed to be distinct from *P. moutan.* (See 'Bot. Mag.,' t. 1768; see also *P. pubens*, t. 2264, and *P. moutan*, t. 1154.)

Pæonia officinalis (see 'Bot. Mag.,' t. 1784) is an old plant, and was common in Parkinson's time, since he observes that the double sort sometimes produces ripe seeds, which, being sown, bring forth some single and some double flowers. (See also *P. humilis*, t. 1422, and *P. daurica*, t. 1441.)

P. tenuifolia is figured in the same work, t. 926.

Ranunculus (*Buttercups*).—This is a large genus of annual, perennial, or aquatic plants, *R. asiaticus* being the type of the florists' or Turban Ranunculus, once highly popular, and still often met with in gardens. This species is a native of the Levant, and is said to have been introduced prior to 1596. The blood-coloured variety, "sanguinea," is a native of Syria;

while the fine-leaved form, "tenuifolius," a white-flowered variety, hails from the meadows and mountains of Greece. The Dutch florists raise numerous seminal varieties annually, and grow the roots for the English market. Selected seed from richly-coloured flowers should be sown as soon as ripe in pans or boxes of light sandy earth, and placed in a light cool pit or frame to germinate. Seeds sown in autumn as soon as gathered, vegetate better than when kept until the spring; and this is true of most other hardy flowers.

R. gramineus is a distinct and beautiful species from pastures or meadows in S. France and Italy. It has glaucous grass-like foliage, and rich, golden-yellow, semi-double flowers.

R. platanifolio-gramineus, an interesting hybrid, was raised in the Botanic Garden at Brussels in 1820, its parents being *R. platanifolius* and *R. gramineus* (see 'Ann. des Sciences Physiques,' t. viii. p. 352). Natural or wild hybrids are known to exist between *R. bulbosus* and *R. acris*, and also between *R. bulbosus* and *R. polyanthemus*. (See 'Bot Zeit.,' Nos. 30-35, 1876, for observations on wild hybrid kinds of *Ranunculus*, *Epilobiums*, *Nymphæa*, *Cirsium*, *Arctium*, *Hieracium*, *Verbascum*, *Lamium*, *Rumex*, *Carex*, *Salix*, *Alopecurus*, and *Calamagrostis*.)

THE BUCKTHORN AND CEANOTHUS FAMILY (*Rhamnaceæ*).

A small group of hardy or half-tender shrubs found scattered over nearly the whole earth's surface, while in our gardens they are represented by Buckthorns—one species, the Red Buckthorn, *Rhamnus hippophae*, being a very pretty, red-berried shrub; and also by several species and numerous seminal varieties of *Ceanothus*, the latter for the most part having been raised in Continental gardens. Propagated by seeds sown in a cold frame, or the tenderer kinds on a gentle bottom-heat. Layers, root-cuttings, and grafting are also successful methods of propagation.

Ceanothus (*Red-root*).—Rhamnaceous shrubs nearly allied to Euonymus. They are much grown in Continental gardens as ornamental-flowering plants, grafted on the stems or roots of *C. americanus*, which may be readily raised from seeds, layers, or cuttings. M. Baltet recommends cleft-grafting in March and April. Pieces of the root having fibres at the end, the scions are simply tied on with bast and then planted out in open-air beds, so as to cover the junction with soil. Root or stem grafting in January and February in a propagating case, or under glass in a gentle bottom-heat, is also successful.

"In selecting portions of root for stocks, be careful to preserve the fibrous roots at the end, clip the leaves of the scion through the middle (to prevent undue evaporation and consequent flagging), place the grafts under *cloches* or frames; the union of the parts is effected in five or six weeks."—*Baltet.* M. May, in the 'Revue Horticole,' recommends for market purposes grafted plants of *Ceanothus*, which form specimens of great beauty. Young plants, with stems as thick as a goose-quill, are taken early in autumn as stocks, and these are grafted the following summer. Very beautiful blue and rosy-lilac varieties have been raised from seed in French and Belgian gardens.

MM. Simon-Louis Frères, Plantières-les Metz, have been successful in raising numerous rosy and blue flowered seminal or hybrid forms of *Ceanothus*, two of the best of which are figured in 'L'Horticulture Belge' (vol. i. No. 2, p. 25). *C. marée Simon* is a bright, rosy-flowered variety, and *C. bleu celeste* is, as its popular name implies, a cerulean blue. The last-named was sent out in 1873, and its rosy congener in 1867.

C. azureus latifolius is a hybrid of Continental origin, having been raised from *C. americanus*, fertilised with pollen from *C. azureus* (see 'Gardeners' Chronicle,' 1864, p. 579).

For a full account of the American genus Ceanothus, see a valuable paper read before the American Academy of Arts and Sciences by Mr S. Watson, and subsequently published in the 'Garden,' vol. vii. p. 29.

The Mangrove Family (*Rhizophoraceæ*).

Trees or shrubs, for the most part natives of the coasts of tropical countries, where they root into the mud and send down roots from the branches—thus, like the Banyan, spreading rapidly, and forming dense thickets,—so dense, indeed, as to prevent due ventilation; hence Mangrove-swamps are known as the most unhealthy places in tropical countries. According to Lindley (see 'Veg. King.,' p. 726), "Mangroves are readily known from every order to which they can be usefully compared by their very curious habit of germinating, while the seeds are still attached to the branch which bears the fruit. The radicle and club-shaped crown of the root gradually lengthen until they enter the soft muddy soil; or, if too high, they drop, and, fixing themselves in the muddy bottom, immediately strike root at one end, while leaves unfold at the other."

THE RUE FAMILY (*Rutaceæ*).

A group of small trees, shrubs, or herbaceous plants, principally natives of South Europe and the Cape of Good Hope, some of our greenhouse species of *Boronia*, *Correa*, and *Eriostemon* being natives of New Holland. The principal genera besides those just named are *Calodendron*, *Adenandra*, *Barosma*, *Dictamnus*, and *Ruta* (Rue). Nearly all the species require artificial fertilisation to insure the production of seed in cultivation. This is, however, but seldom resorted to, as nearly all these plants are readily multiplied by cuttings or layers. It does not appear to be generally known that the different species of *Eriostemon* succeed well grafted on the strong-growing species of *Correa* as stocks; and *Correa cardinalis* and one or two others form more bushy and floriferous plants when grafted on *C. alba* than when grown from cuttings on their own roots. Plants for stocks should be struck from cuttings, and as soon as they are rooted they can be splice-grafted in a close case. Several pretty varieties of *Correa* have originated in our gardens from seed. *Boronia Drummondii alba* is a pure white-flowered plant, raised by Mr W. Smythe, then of Elmham Hall Gardens, Norfolk, some time about 1867. It is the result of a cross effected between *Boronia Drummondii* and *B. pinnata*, both of which bear pink flowers. *B. Drummondii* was the seed-bearing plant, and the hybrid resembles it, except in the colour of the flowers.

Correa (*Native Fuchsias*).—A small genus of Australian plants, represented in our gardens by one or two species and several seminal or cross-bred forms. I find no records of hybrids, although these plants appear to have been much improved soon after having been introduced to cultivation. The following varieties are seminal ones: *C.* "Brilliant," *C.* "Cavendishii," *C.* "cardinalis," *C.* "delicata," *C.* "Jardin d' Hiver," *C.* "magnifica," *C.* "Ne Plus Ultra," *C.* "speciosa ventricosa," and others. Eriostemons struck from cuttings in a gentle bottom-heat form excellent stocks on which to graft these seedling varieties of Correa, and especially such as do not flower freely on their own roots. Numerous seedlings, varying in colour from white to crimson, were raised by Mr Gaines prior to 1848.

Eriostemon (*Australian May*).—A small genus of white-flowered shrubs, represented by *E. amœnum*, *E. buxifolium*, *E. intermedium*, *E. linearifolium*, *E. neriifolium*, *E. pulchellum*, *E. scabrum*, all well-known greenhouse plants. They strike tolerably well from cuttings of the young growth in heat; or cuttings grafted on their own roots succeed well.

The Willow and Poplar Family (*Salicaceæ*).*

A small group of amentaceous or catkin-bearing trees, represented in our gardens and woods by numerous forms of *Salix* (Willows) and *Populus* (Poplars). They are natives of nearly all northern countries. The male and female flowers are borne separately; and in the case of the Willow, numerous natural hybrids have been from time to time produced. Many of the species and forms are much valued by the basket-maker, and the wood of Willows is valued for turnery. Seeds of both Willows and Poplars grow readily sown as soon as ripe in open-air beds of moist earth. Both genera are remarkable for their rapid growth, and they may be readily multiplied by cuttings of the young shoots inserted in beds of moist earth in mild weather during the autumn or winter months. Large branches or truncheons, four or five feet in length, root freely if driven into moist earth, and Willows are frequently so propagated for fences along brooks and rivers or other water-margins. The natural hybrids or cross-bred varieties of Willow to be found in Britain are wellnigh innumerable, the variations (like those of the British *Rubi*) being in many cases abundantly evident to the eye, but it is quite impossible to describe them in an intelligent manner. Loudon enumerates over 250 varieties as being cultivated in his time. Willows and Poplars grow so freely from cuttings of the branches, even of a considerable size, that grafting or budding is rarely resorted to. The Weeping Willows, however, are often budded on the Common Willow or *S. caprea* as a stock; and the White Poplar, Black Poplar, and Aspen form excellent stocks for their sub-varieties and allies. In budding Willows, when the stocks are slender, bend them so as to bury the inserted bud in the soil for a week or two, as this assists the union: some bandage with moss instead.

The Horse-Chestnut Family (*Sapindaceæ*).

A group of trees and shrubs, principally confined to the tropics, especially of South America, India, and Africa. None are wild in Europe, the most northern type being the Horse-Chestnuts in North India, Persia, and North America. It is curious to note that while many plants in the order are poison-

* See Wichura's Observations on the Hybridisation of Willows, 'Jour. Royal Hort. Soc.,' 1866, vol. i., p. 57.

ous, others, as the *Litchi*, the Lougan, and the Rambutan, are in India and China much valued as delicious fruits, and these are produced by different species of *Nephelium*. The Horse-Chestnut (*Æsculus*) and the North American species of *Pavia* are best known, but the following genera are represented in our gardens: *Cardiospermum*, *Paullinia*, *Melianthus*, *Greyia*, *Sapindus*, *Cupania*, and *Kœlreuteria*, and several others, including *Xanthosceras*. *X. sorbifolia* is a low and very striking ornamental-flowering tree, rivalling the Pavias and Horse-Chestnuts in beauty (see 'Garden,' viii. 524). Root-cuttings of this plant grow freely, every little piece forming a plant. It would be interesting to know whether this plant cannot be propagated by grafting on the roots or stems of *Kœlreuteria paniculata*, or on either Pavias or Horse-Chestnuts.

Melianthus majus is readily propagated by cuttings of the root-stock or lateral growths, having a heel of old wood at their base, and root-cuttings are also successful. *Greyia Sutherlandii* (see 'Bot. Mag.,' t. 6040) is a scarlet-flowered shrub, something resembling Melianthus, but with simple leaves. This plant may be propagated from cuttings of the partially-hardened young growth or from root-cuttings in a genial bottom-heat of 70° to 80°. This plant, albeit a showy one, flowers so seldom in cultivation (unless starved nearly to death), that it is worth while trying whether it cannot be grafted on some other Sapindaceous plant, with a view to restricting its vegetative or leafy growth.

Æsculus (*Horse-Chestnuts*).—The Common Horse-Chestnut, *Æ. hippocastanum*, is well known as one of the most distinct of all our shade trees, while as a flowering tree it is unsurpassed. A noble avenue of these trees, nearly a mile in length, exists in Bushy Park, near Hampton Court Palace, and these present a most attractive sight when in full bloom. It is supposed to be a native of Asia and Northern India. Another species, *Æ. ohiotenses*, is not uncommon in North America, where it is known as the "Buckeye," and there is a variety of the Common Horse-Chestnut which bears soft rosy flowers. It is one of the easiest of all forest-trees to propagate, as it bears enormous quantities of seeds, which germinate freely if sown in trenches as soon as they fall from the tree in autumn. Like most other trees raised from seeds, it is liable to vary greatly in both leaf and flower, but any particularly good or desirable form may be perpetuated by shield-budding on seedling stocks in June and July. Cleft-grafting close to the ground in March also succeeds; and flute-grafting or crown-grafting in April, either as dwarfs or standards, succeeds well. The "Scarlet Horse-Chestnut" belongs to the allied genus *Pavia*, most species of

which genus succeed well on the Common Horse-Chestnut as a stock (see Pavia).

In the nurseries of M. Scipion-Cochet, at Suisnes, is a Chestnut-tree of unusual aspect, presenting characters intermediate between those of the Common Horse-Chestnut (*Æsculus hippocastanum*) and the Red Chestnut (*Æ. rubicunda*), but so mixed up that it is difficult to say to which of these the tree is most nearly related. M. André, consequently, in the 'Revue Horticole,' proposes to call it *Æ. intermedia.* The tree is of medium size, and of erect, pyramidal form, like the Horse-Chestnut, but has shorter wood. The leaves are like those of the Red Chestnut, with five oval-cuneiform, acuminate, coarsely dentate lobes, having sharp teeth. The flowers form a compact irregular thyrse, the calyx being rose and green, the petals yellowish white, the two upper ones spotted with yellow at the base, passing to salmony rose, and the stamens having bearded rosy filaments. The capsules are sometimes quite smooth; sometimes, and more frequently, bristling with projecting points.

This curious tree came from a seed of the Red Chestnut, sown about 1843. As it is well known that the seedlings of this tree are very variable, M. André inquires whether in this we can trace the result of a fertilisation with the widely-spread White Chestnut, or the first stages of a reversion from the Red Chestnut to the Horse-Chestnut.

Pavia (*Pavias*).—A beautiful group of North American or Japanese trees, most of which bear erect panicles of white or yellowish flowers, and distinguished from Horse-Chestnuts "by having a smooth, not prickly, capsule." Several varieties of *P. rubra*, or Red-flowered Chestnut, are grown in our gardens, where it serves for grouping, along with the white-flowered Chestnut, just as pink Thorns are contrasted with the Common Hawthorn. *P. flava* has very beautiful orange-yellow and brown foliage in autumn; and *P. macrostachya* flowers in August in London gardens as a low-growing tree, and its numerous elegant spires of white flowers render it a most attractive object. *P. discolor* is also well worth more general culture. The Pavias may be propagated either by seeds sown in the open air in spring, or by cuttings or layers. In some nurseries it is usual to graft or bud these plants on seedlings of the Horse-Chestnut as a stock; and M. Baltet recommends shield-budding with a cross incision in July, or cleft, flute, or crown grafting in March and April. The buds at the base of the scion branches do not break so readily as those in the centre; so the latter ought to be selected, and the ends of the shoots are crown-grafted, to economise the scions.

The American Pitcher-Plant Family (*Sarraceniaceæ*).

We have here a curious group of herbaceous plants, all natives of the North American bogs, if we except *Heliamphora nutans*, which is found in Guiana. They are represented in our gardens by about a dozen species and varieties of *Sarracenia* or "Side-saddle Flowers," and by the rare and beautiful Californian *Darlingtonia*, which, like the Sarracenias, has a hollow inflated petiole, narrow at the base, and widening as it nears the apex; and the petioles, or "pitchers," as they are popularly called, are well known to entrap insects in large quantities. All the species are propagated by offsets or by carefully dividing established plants; but a still surer method is to cut the root-stock up into small pieces, sowing them like seeds in a genial bottom-heat of about 70°. Seed is readily obtained from strong-flowering plants by cross-fertilising the large five-lobed umbrella-like stigma of one individual with pollen from other flowers, and the seeds so obtained should be sown as soon as ripe on the surface of a finely-prepared seed-pan, after which treat it exactly like seeds of Chinese Primulas. The most distinct species of *Sarracenia* are *S. Drummondii*, *S. flava* (a variable plant), *S. rubra*, *S. psittacina*, and the common "Huntsman's Cup," *S. purpurea* (see 'Bot. Mag.,' t. 840). Grown in spongy peat and living sphagnum moss, these plants and the *Darlingtonia* are very attractive. It would be interesting to know whether hybrids between the last-named plant and the genus *Sarracenia* can be obtained. Natural seedlings of the last-named vary considerably; and I remember seeing a plant in the Holloway Nursery in 1873, exactly intermediate between *S. purpurea* and *S. flava*. We have two well-authenticated hybrid Sarracenias, and there is yet a wide field in this genus for more honours to be won.

S. Moorei is a hybrid raised by Dr D. Moore of Glasnevin, between *S. flava* fertilised with pollen from *S. Drummondii*, and is exactly intermediate between the two parent plants. The plant grows eighteen inches to two feet in height, and bears purple flowers (see 'Gard. Chron.,' 1874, p. 702).

S. Stevensii is another hybrid of great interest, and was raised by Mr Stevens of Trentham. It is the result of a cross between *S. purpurea* and *S. flava*, and in habit of growth resembles the last-named with the red veins of the other parent (see 'Gard. Chron.,' 1874, p. 738).

S. Williamsii, an intermediate which originated in the Hol-

loway Nursery. In speaking of these two last-named plants, Mr Thomas Moore observes: "These two plants have the same parents—namely, *S. purpurea* and *S. flava*—but they are so different in aspect, that we have little doubt the crosses were made the reverse way." Mr Stevens's plant more nearly resembles *S. purpurea*, though it has an erect habit, since it combines the bulging form and purple veining and coloration of that species. Mr Williams's plant, on the other hand, has a greater resemblance to *S. flava*, being larger and erect, less coloured, with a large lid, but having the pitcher more broadly winged, and in this respect approaching its other parent. These hybrids are plants of very great horticultural interest."

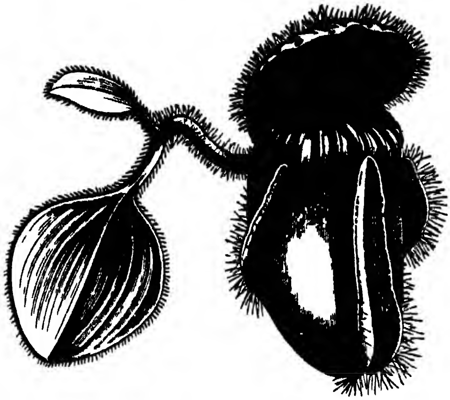
THE SAXIFRAGE FAMILY (*Saxifragaceæ*).

A small family of herbaceous plants, principally natives of Europe, the majority being found in cool mountainous districts, where they grow in dense patches, or occasionally solitary. They are represented in our gardens by numerous forms of *Saxifraga*. Propagation is easily effected in the case of the gregarious species by careful division, while nearly all the kinds seed freely, and the seeds germinate readily sown in pans of sandy earth in a cold frame, or where they are to remain in sheltered niches of rockwork or on old retaining walls.

Entire tuft of Cephalotus follicularis (smaller than nature).

It is singular to observe that the stamens of some of the Saxifrages vary in length, and also in the period of their full development, as in *Tropæolum*, and each stamen bends over in the direction of the stigmas when the pollen is ripe, as if to favour self-fertilisation; but of this we need better proof. Some of the species—as *S. megacea*, *S. nepalensis*, *S. pyramidalis*, and others—are of noble habit, bearing a showy spire-like inflorescence two or three feet in height. Nothing appears to have been done in the way of hybridising species of this genus; so that here is an untrodden path for some intelligent adventurer.

The Australian Pitcher-plant (*Cephalotus follicularis*) is one



A pitcher of Cephalotus follicularis, natural size, with two normal leaves.

of the most singular plants in the order, and is easily propagated by careful division or by root-cuttings.

THE SNAPDRAGON AND LINARIA FAMILY (*Scrophulariaceæ*).

A group of showy-flowered annuals, herbaceous plants, or shrubs, distributed nearly all over the world, from the coldest regions in which the vegetation of flowering-plants takes place, to the hottest places within the tropics. In North America they are said to form a 36th of the flowering-plants, and in the middle of Europe about a 26th. In our gardens we have the following genera: *Browallia*, *Brunsfelsia*, *Salpiglossus*, *Schizanthus*, *Calceolaria*, *Verbascum*, *Scrophularia*, *Celsia*, *Alonsoa*, *Linaria*, *Antirrhinum*, *Maurandia*, *Lophospermum*, *Phygelius*, *Pawlownia*, *Chelone*, *Pentstemon*, *Leucocarpus*, *Diplacus*, *Mimulus*, *Torenia*, *Sibthorpia*, *Buddleia*, *Digitalis*, *Veronica*, *Gerardia*, *Pedicularis*, *Sanchezia*, and others. Nearly all the Figworts bear an abundance of fertile seeds, and these germinate readily if sown in light sandy earth. The hardy kinds, as *Digitalis*, *Pentstemon*, *Chelone*, and others, may be best treated as biennials. *Phygelius*, *Pawlownia*, *Calceolaria*, *Sanchezia*, *Brunsfelsia* (Franciscea), *Browallia*, and other shrubby or semi-shrubby kinds, root freely from cuttings of the young or partly-hardened growth inserted in a close case, and these also may in

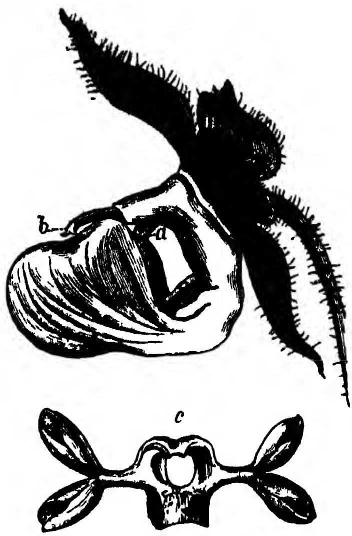
many cases be multiplied by seeds sown in heat, or by layers. M. Porcher (see 'Du Fuchsia,' 4th ed. p. 27, 28) mentions a hybrid between *Verbascum blattaria* and the Water-betony, *Scrophularia nodosa*; and, as is well known, there are several natural hybrids between the species of the first-named genus. *V. nigro-blattaria* is a hybrid between *V. nigra* and *V. blattaria*, and was discovered by M. Diny near Schlestadt.

Antirrhinum (*Snapdragon*).—A genus of ten or fifteen species of annuals or sub-shrubby plants, natives of the Mediterranean region, a few being found in California. *A. majus* is the best known in gardens, its seminal forms being innumerable. As a plant for clothing old stone walls or dry stony banks, this plant has no equal. All the species seed freely, and the seed germinates readily sown in autumn or as soon as ripe. Any desirable form may be perpetuated by cuttings of the young lateral growth. It would be interesting to know what results would follow if *A. latifolium*, which is a native of S. Europe, was used along with *A. siculum* and *A. asarina* for crossing with the common improved forms of *A. majus*. Very interesting results might possibly be obtained by hybridising some species of *Linaria* with this reciprocally. Antirrhinums have of late years been much improved by careful selection, and we have now several races, and some of the most showy kinds have been named, these being perpetuated by cuttings. A variegated-leaved Antirrhinum which originated in the gardens at Mellerstain, Berwickshire, is interesting, as plants raised from cuttings of the variegated growth have withstood the frosts of winters (1873-74), having assumed the form of shrubs, while the ordinary green-leaved varieties were killed.

Buddleia (*Buddleias*).—A large genus of American, Indian, and S. African plants, represented in our gardens by the purple-flowered *B. Lindleyana*, the orange-flowered *B. globosa*, and others. They are readily propagated by cuttings of the ripened wood or of the roots. Seeds are sometimes produced on warm dry soils, and these germinate readily, sown as soon as ripe in pans of rich light earth, and placed on a shelf near the glass. *Buddleia intermedia* (see 'Revue Hort.,' 1873, p. 151) is a hybrid between *B. curviflora* and the well-known *B. Lindleyana*, and it is singular to notice that although the first-named species was the seed-bearing parent, the offspring, in habit of growth and colour of flower, more closely resembles the male parent, *B. Lindleyana*. *B. curviflora* seeds very freely, hence is a good female parent, but *B. Lindleyana* rarely produces fertile seeds.

Calceolaria (*Slipperworts*).—A well-known genus of perennial herbaceous plants or shrubby evergreens, principally natives of Chili and Peru, one species, *C. Fothergilli*, being a native of the barren coast of the Falkland Islands. *C. floribunda*, a yellow-flowered species, is one of the hardiest in the group, and was introduced in 1843 from the Andes of Quito, where it is found at an altitude of 10,000 to 11,000 feet. *C. scabiosæfolia* is quite hardy in some gardens, where it becomes naturalised as an annual. It was introduced from Chili in 1822, and, though not so showy as some others, might be valuable for hybridising purposes on account of its hardy character and elegant habit. *C. amplexicaulis*, a pure, yellow-flowered, tall-growing species, introduced from Peru in 1845, is still cultivated in gardens in its pure state as a bedding-plant. *C. Fothergilli* was the first species cultivated in this country, having been introduced so early as 1777, and this was followed by *C. corymbosa*, *C. integrifolia*, and its narrow-leaved variety, *angustifolia*, and *C. scabiosæfolia*, all introduced from Chili in 1822. All the species may be propagated freely, either from cuttings of the young herbaceous growth, or from seeds sown in a gentle bottom-heat either as soon as ripe in autumn or early in the spring. Seed is saved from bright-coloured, well-shaped varieties, and fifty well-grown plants produce about 1 oz. of seed, this being worth about £10. Seed for summer blooming should be sown in August in well-drained pots or seed-pans: cover the drainage with fibrous loam, and fill up with fine light sandy earth; water with a fine-rose watering-pot, after which sow the seed, placing a piece of glass over the pot to retain moisture, no covering of soil being required. Place the pots in a frame or under a bell-glass, taking care to shade from the sun. Remove the piece of glass as soon as the plants are up, and when large enough to handle, prick off one inch apart into pans made up as before; place in a somewhat close situation, and when of sufficient size pot off singly. All the dwarf-habited, large-flowered, richly-spotted varieties belonging to the "florists'" or herbaceous section have been brought to their present state of perfection by hybridising and careful selection. In some species of Calceolaria the style is exserted and receptive before the pollen is discharged from the anthers, as if naturally to facilitate fertilisation by the pollen from other more fully developed flowers on the same plant. This circumstance renders artificial cross-fertilisation or hybridisation comparatively easy. In *C. Pavonii*, a large and showy, half-hardy, yellow-flowered species, with

connate, halberd-head-shaped leaves, now in cultivation at Kew, the exserted style is separated from the anthers by the swollen top of the slipper, as shown in the accompanying engraving; and Professor Oliver kindly informs me that Hildebrand describes a similar contrivance to insure protogyny in *C. pinnata* in the 'Botanische Zeitung' (1867), with illustrations. This contrivance is analogous to others which have been repeatedly observed in species of Agave, Primula, and in most Composites. Gaertner observes, in his work on hybridism previously alluded to: "Of all genera, Calceolaria seems to present the greatest tendency to hybridise; the pure species unite with the utmost facility, and their hybrids are all fertile and disposed to fresh admixture; even the fruticose Calceolarias unite with the herbaceous section or *C. plantaginea* (1826)—(see Herbert's 'Amaryllidaceæ,' p. 363, and 'Bot. Mag.,' t. 2805). *C. arachnoidea* (see 'Bot. Mag.,' t. 2874) has woolly or cobweb-like lanceolate leaves, and bears conspicuous panicles of bright purple flowers. *C. rugosa* (see 'Bot. Mag.,' t. 2523) is one of the progenitors of our dwarf, yellow, bedding race, and bears rather dense panicles of small golden flowers. The leaves are much netted, bright green above and tawny beneath (see also *C. integrifolia*, 'Bot. Reg.,' t. 744). *C. corymbosa* (see 'Bot. Mag.,' t. 2418) is one of the most showy of the Chilian species, and bears rather lax panicles of long-pocketed, orange-yellow flowers. I can remember seeing these long-flowered, slender-habited forms in cottage-windows fully twenty years ago. Other interesting old species may be found in Sweet's 'Flower Garden,' Paxton's 'Magazine of Botany,' and the 'Botanical Register' or Loddige's 'Cabinet.' *C. pisacomensis* (see 'Bot.



Calceolaria Pavonii a anther, b, style; c, base of slipper and anthers enlarged.

Mag.,' t. 5677) is one of the finest of all the twenty-three species of this genus figured in the 'Botanical Magazine,' and it is so distinct in habit, and bears such a profusion of orange-red flowers, that it ought to be invaluable to the hybridiser. The flowers of this plant are similar in form to those of *C. Pavonii*, and appear to be protandrous in much the same way.

Digitalis* (*Foxgloves*).—A genus of erect-growing herbaceous biennials or perennials, principally natives of temperate countries, and represented in our rocky dells and woodland hedges by *D. purpurea*, the Common Foxglove, a poisonous plant by the by, but a most stately and handsome one, nevertheless. A medicinal extract (*digitaline*) or infusion of the leaves is prepared from this plant, and is of value in *delirium tremens*, dropsy, and heart disease; but the action of this medicine is so subtle that none but the most practised medical man should attempt to administer it. Several species are grown in gardens, including *D. grandiflora*, *D. ferruginea*, and *D. lutea* (see Parkinson's 'Paradisus,' p. 381, figs. 4, 5, 6). The white-flowered variety of the purple English Foxglove was known in Parkinson's time, since he describes it as being grown in gardens, and also says it is found wild along with the purple form. Although little appears to have been done in a systematic manner to improve the white and rosy-purple varieties of *D. purpurea* by cross-breeding, yet culture has worked some marked changes, and by hybridising with other species we may hope to obtain a race of seedlings of a good strain, the flowers of which, while rivalling those of the *Gloxinia* in purity of colour and diversity of markings, are borne on a much more noble and stately plant. Here is a good field for all lovers of handsome hardy flowers. In 1769 Koelreuter hybridised these plants, and obtained seedling hybrids, which reproduced themselves from seed. I cannot just now lay my hands on the records of these crosses, but I believe references to many of Koelreuter's papers are given in Herbert's 'Amaryllidaceæ.' Among these hybrids are *D. purpurascens*, and a whole race of fertile hybrids between *D. purpurea* and *D. Thapsi*, *D. ferruginea* and *D. ambigua*, and *D. purpurea* and *D. canariensis*. A hybrid between *D. purpurea* and *D. ambigua* has been raised in the Paris Botanic Garden (Jardin des Plantes).

Linaria (*Toad-flax*).—A group of annual or herbaceous perennial plants, natives of Africa, America, and Europe, and represented in England by the graceful little "Ivy-leaved Toad-flax" (*L. Cymbalaria*) and by the common *L. vulgaris*, of

* See 'Digitalium Monographia,' with descriptions of Foxgloves by Dr Lindley, and drawings by F. Bauer.

which regular-flowered, fine-spurred sports sometimes make their appearance, which it might be quite possible to perpetuate. A race of these regular-flowered Linarias would be very curious and beautiful. *L. speciosa* is often grown as a flower-garden annual, and *L. triornithophora* is a curious and beautiful plant, much grown in German gardens, but neglected in this country. *L. maroccana*, a showy purple-flowered annual from Marocco (see 'Bot. Mag.,' t. 5983), and *L. heterophylla*, a whitish-flowered plant from the same locality (see 'Bot Mag.,' t. 6041), well deserve attention. Hybridised with each other, or *L. vulgaris*, one might obtain a beautiful race of showy annuals. Nearly all the species of this genus are beautiful, and here is a good field for the intelligent hybridiser. *L. vulgaris* and *L. purpurea* have already given numerous hybrids, of which M. Naudin writes as follows (see 'Jour. Royal Hort. Soc.,' 1866, p. 6): "I observed in 1863 and 1864 the sixth and seventh generations of a hybrid which I have kept for several years, *Linaria purpurea-vulgaris*, both represented by some hundreds of individuals. A good number of these last reverted—some completely, the others partially—to the form of *L. vulgaris* with yellow flowers; a small number to those of *L. purpurea* with purple flowers. Others still more numerous inclined towards neither the one nor the other, but nevertheless did not resemble the hybrid of the first generation. There were all possible kinds of variation—tall or dwarf stature, broad or narrow leaves, the corolla deformed in various ways, discoloured, or exhibiting unusual tints; and out of all these combinations there did not result two individuals which were perfectly alike. It is very clear that we have to do here with irregular variation, which engenders only individualities, and that uniformity is not established between the descendants of hybrids, except on the condition that it resumes the normal livery of the parent species." Now here, as it seems to me, we have dissociated or unbalanced characteristics, partly due to the unison of the latent and evident characters of the parent species, and partly to cultivation. In some of these hybrids the characteristics of *L. purpurea* predominate—that is to say, they either crush out, or at all events render latent, the characteristics of *L. vulgaris*, while sometimes the reverse of this is the case. Some of these hybrids, however, are apparently more or less intermediate—that is to say, the mixed characters each to a certain extent hold their own, a sort of "split-the-difference" compromise being made between them; but in no two cases is there any fixity of character—no tendency to form a permanent race.

This state of things is common to nearly all hybrids, but fixity of character may be secured by crossing these hybrids with a third species or distinct hybrid of other parents, and, as we have already pointed out, this plan has repeatedly succeeded in fixing the characters of hybrids and in forming distinct races of garden plants. The introduction of a third set of characteristics into hybrid plants gives them stability of character, just as three legs are necessary to a table.

Mimulus (*Musks and Monkey-flowers*).—A small group of very showy garden perennials, represented by *M. moschatus* ("Common Musk"), *M. luteus* (see 'Bot. Mag.,' t. 1501), *M. aurantiacus* (see 'Bot. Mag.,' t. 354), *M. cardinalis*, an old scarlet species often cultivated along with Musk in cottage-windows, and *M. repens* (see 'Bot. Mag.,' t. 5423). Most of the species are American, and *M. luteus* and *M. moschatus* are quite hardy, and indeed naturalised in many parts of this country. The many variable forms of Mimulus cultivated in our gardens have been derived from *M. luteus* and *M. aurantiacus*, fertilised with pollen of *M. cardinalis*, more recently, however, a new and very handsome large-flowered race has been originated by crossing the varieties of *M. luteus* reciprocally with *M. luteus* var. *cupreus* (see 'Bot. Mag.,' t. 5478), these forms being characterised by large orange-yellow flowers, boldly blotched with rich coppery brown. Nearly all the species of *Mimulus* cross with each other freely, and hybrids have been obtained between *M. luteus* and *M. guttatus*, *M. aurantiacus* and *M. puniceus;* while *M. cardinalis*, *M. guttatus*, *M. luteus*, and *M. glutinosus* are all susceptible of hybridism and cross-breeding. M. V. Lemoine and M. Ingelrelst of Nancy have much improved Mimuluses by cross-breeding, and Messrs E. G. Henderson & Sons have produced a very handsome strain of *M. luteus* and *M. cupreus* in this country. *Mimulus moschatus Harrisoni* is a beautiful hybrid between *M. moschatus* or Musk plant and *M. maculatus* or spotted Mimulus. It has the fragrance of Musk, with much larger red-spotted flowers. All the species are very easily propagated by seeds, or by dividing the underground stems. Every bit of the root of *M. moschatus*, *M. luteus*, and other species, will develop into plants if placed in moist sandy soil. Seeds grow freely treated like those of *Calceolaria*. In the 'London Journal of Botany,' 1873, p. 101, Mr Kitchener, F.L.S., has some interesting observations on the irritability of the flowers of *Mimulus*, from which we learn that Sprengel had previously noticed this proper motion (Sprengel's 'Anleitung Zur. Reuntniss. der Gewächse,' part i. p. 274). Mr Kitchener remarks in the

Journal above cited: "I am not aware that any connection has been noticed between the stigmatic movements of Musk and the necessity of insect fertilisation. Vaucher remarks that during *the time of fecundation*, *M. luteus* and *M. glutinosus* will, as he himself has tried, close at the slightest touch. The sensitiveness will be seen to play a useful part in fecundation.

"I will take the commonest species, *M. moschatus*, as a type. The flowers vary from erect in the bud to horizontal in the full-blown flower, but never hang downwards. Of the four stamens, the anterior, lower, and larger pair ripen after the posterior, upper, and shorter pair. Both pairs of anthers are held together by hairs, and the longitudinal slits of the anther open towards the lower lip, and away from the base of the flower. The style is closely pressed against the upper lip of the corolla, and its stigma has two large, flat, fan-shaped lobes. In a very young bud these lobes are closed. In a hardly-opened bud the lobes are beginning to open, the lower one bending back against the style: at this time it is that the shorter stamens burst; but, as they are much shorter than the style, the pollen cannot reach the stigma, and its course down the tube is facilitated by the, at that time, slanting position of the flower. In a just-opened flower the stigmas are fully open, parallel, and opposite to the lower lip of the corolla, its viscous surfaces being therefore both downwards; the shorter anthers are nearly empty, and the longer ones only just beginning to split; the pistil is therefore synacmic with the shorter, and almost protogynous with respect to the longer stamens.

"In a flower almost beginning to fade the longer stamens are still shedding their pollen, the shorter ones are withered, and the stigma be-pollened and in many cases closed. This closing may, moreover, be experimentally produced by touching the stigmatic surface with a pencil, in which case the stigmas will close in about thirty seconds. In faded flowers, whether from contact or otherwise, the stigmatic surfaces have closed.

"From these facts it will appear that self-fertilisation by the shorter stamens is impossible, and that self-fertilisation by the longer stamens is rendered improbable, (1) by their bursting late; (2) by the direction in which the anthers open; (3) by their not reaching as far as the stigmas, and, as being anterior, by being some slight distance from the upper lip; (4) from the probability that the stigmatic surfaces may have been touched and closed before they burst at all.

Pentstemon (*Lady-gloves*).—A group of favourite border or florists' flowers, and for the most part American, and readily

propagated either from seeds or cuttings of the young growth, which may be struck readily in May or June in a cool frame, if covered with a hand-light. The cuttings should be inserted in a thin layer of sand. Some of the blue or purple flowered Californian species are very pretty. The florists' varieties of Pentstemon have been derived from *P. gentianoides*, a native of Mexico; and, according to some authors, it has been hybridised with *P. Cobæa* and *P. Hartwegi*. Seed germinates readily sown in spring.

Hybrid Pentstemons.

Here again considerable improvement might possibly be effected by crossing the best of the new seedlings with *P. Palmerii*, *P. humilis*, or other of the recently-introduced Californian species. The best varieties of Pentstemon rival the tropical Gesneras in profusion of flowers and brilliant colouring; and our native Foxglove, a nobler plant than either, and more hardy withal, is comparatively an unknown plant in our gardens. If some intelligent florist would but take up the improvement of the Foxglove, *D. purpurea* and its varieties would soon become one of the handsomest of all hardy garden flowers.

Veronica (*Veronicas or Speedwells*).—A large group of ornamental plants, principally natives of Europe, New Zealand, and other temperate climes. They are naturally divided into two distinct groups, the herbaceous European section being

represented by *V. spicata*, while the shrubby kinds are principally from New Zealand — *V. salicifolia*, *V. Hulkeana*, and others, being frequently met with in good gardens, where they flower throughout the winter in mild seasons. *V. parviflora*, var. *angustifolia*, is a most graceful variety (see 'Bot. Mag.,' t. 5965), described by Dr Hooker as passing into *V. salicifolia* on one hand, and *V. macrocarpa* and *V. ligustrifolia* on the other. In describing this plant, the learned doctor remarks—"I have little doubt but these and other New Zealand species hybridise extensively in their own country." In cultivation, numerous hybrids and seedlings have been raised by Mr Anderson-Henry and other intelligent amateurs. In the 'Journal of the Royal Horticultural Society,' 1873, p. 105, are the following notes on hybrid Veronicas from the pen of Mr Anderson-Henry: "Among the batch of seedlings from which I obtained *V. Andersonii* (*V. salicifolia* (syn. *V. Lindleyana*) × *V. speciosa*) came one, which, to all appearance, was a reproduction of the male parent pure and simple; and deeming it nothing else, I presented it to a friend, *V. speciosa* being then comparatively a new plant; and he, when he flowered it, came to tell me that in flower it was very different to the true *V. speciosa*, having much longer flower-spikes, the flowers being light crimson instead of dark purple. A plant of this hybrid has since afforded a further illustration of a somewhat similar result. Having obtained a suffruticose species of *Veronica*, under the name of *V. Daubeneyiana*, with light-bluish flowers, striate with pink lines in the way of *V. fruticulosa*, I crossed it on the last-mentioned hybrid (*V. salicifolio-speciosa*), which became the seed-bearer. From this cross I raised two plants, both of which seemed alike in foliage and habit, and both so like the seed-bearer that I felt doubtful whether the cross had taken. One of these flowered during 1873 for the first time, and the singularity of its flowers drew my attention to it more particularly than before. It had, like the seed-parent, thick, fleshy, pyriform leaves, but rather smaller and more closely set on the stem; and instead of being like it, cruciform, they were obliquely decussate, therein slightly approaching the male parent, a creeping Alpine species, whose prostrate stems show still more the deflected arrangement of the leaves. It was only on a close examination of the plant that the resemblance to the male *V. Daubeneyiana* could be observed. In fact, I looked upon it as another of the *many failures* I had had in my attempts to effect the inverse cross on it. When it at last bloomed, my hopes of having effected a partial cross, if I may use such a term, were strengthened. Like *V. Daubeneyiana*,

which has a spikelet with a few blooms, it came even short of it, having had only two flowers, and these much brighter in colour, and no nearer to the male than the hybrid female parent; but whether this is its true permanent character I dare not assert, as it bore no more than this one spikelet of two flowers.

"In the first of the above instances the hybrid seemed, till it flowered, a repetition of the *male* parent; in the second, it seemed, till it bloomed, a repetition of the *female* parent, with such slight differences in the arrangement and slightly smaller size of the foliage as might occur in a purely normal seedling. In fact, seldom have I ever seen two hybrids with so much of one parent, and so little of the other."

V. Andersonii, one of the best and hardiest of all Veronicas, forming a free-blooming seaside shrub in nearly all parts of our coast, is a hybrid obtained by Mr Anderson-Henry in a batch which resulted from seeds of *V. salicifolia* fertilised with pollen of *V. speciosa*.

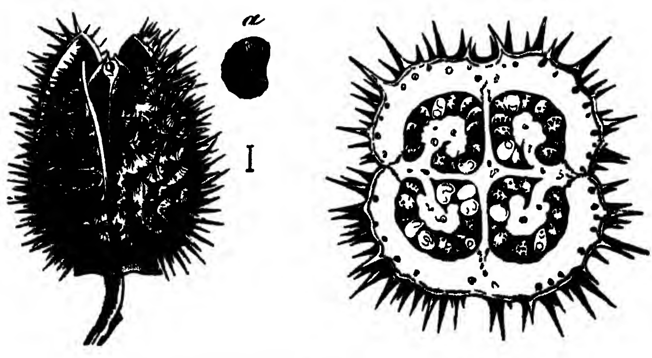
Veronica Balfouriana is a hybrid between *V. saxatilis* and *V. fruticulosa*—and curiously enough, as related by the raiser, J. Anderson-Henry, Esq., it is not only fertile, but seeds more abundantly than either parent; and the same gentleman observes—"I find its self-sown seedlings to bear flowers of various shades of blue, violet, and red, some having actually larger, finer, and higher-coloured blooms than the parent bearing the seed, and I am familiar with the same result in other plants" (see 'Gard. Chron.,' 1853, p. 534; or an article on "Practical Instructions for Hybridising," from the pen of J. Anderson-Henry, Esq.)

The Potato and Nightshade Family (*Solanaceæ*).

A rather large group of herbaceous plants or shrubs, natives of most parts of the world, especially within the tropics, in which, Lindley remarks, the mass of the order exists in the form of the genera *Solanum* and *Physalis*. They are represented in our gardens by the following genera: *Nicotiana* (Tobacco), *Datura* (Thorn-apple), *Brugmansia*, *Schizanthus*, *Salpiglossis*, *Petunia*, *Nierembergia*, *Lycium* (Duke of Argyll's Tea-tree), *Solandra*, *Brunsfelsia*, *Franciscea*, *Cestrum*, *Habrothamnus*, *Fabiana*, *Physalis* (Cape Gooseberry), *Capsicum*, *Solanum* (Potato), *Lycopersicum* (Tomato). The last-named plant is a native of Peru, and, apart from its utility as a grateful esculent, it is interesting as an illustration of floral and fruit fasci-

nation, hence the irregular nature of its scarlet ribbed fruits. *L. esculentum* is the one generally cultivated for food, and *L. cerasiforme* and *L. pyriforme* are grown as ornamental plants. These are considered as distinct species by botanists; but they cross readily with each other and with *L. esculentum*. An elegant variety, called the "Grape Tomato," was exhibited at South Kensington in 1875, and this was obtained by crossing the "Cherry-fruited Tomato" (*L. cerasiforme*) with "Hepper's Goliah," one of the best cultural forms of *L. esculentum*. It bears long clusters of fruit as large as blackbirds' eggs, and of a bright scarlet colour. The "New Greengage Tomato" is a beautiful yellow-fruited form of the last-named species, its fruits being about the size of pigeons' eggs, and of an excellent flavour. (For a paper on the species and varieties of this esteemed fruit, see 'Trans. Hort. Soc.,' iii. 342.) M. Naudin gives particulars of some Petunia hybrids, raised by himself, in the 'Revue Horticole,' 1861, p. 396.

Datura (*Thorn-Apples*).—A group of poisonous plants, principally annuals, and natives of the tropics. One species, however, *D. Stramonium*, is a weed in this country. All are readily



Ripe fruits of Datura Stramonium, L   a, Ripe seed enlarged

multiplied from seeds, sown in the open air in spring. Numerous hybrid Daturas have been raised by M. Naudin (see 'Jour. Royal Hort. Soc.,' 1866, p. 2). "In 1862 M. Naudin made numerous crosses, all of them successful, between *Datura lævis*, *ferox*, *Stramonium*, and *quercifolia*, four species perfectly distinct, between which there are no known (natural) intermediates, and which, moreover, do not appear susceptible of variation. *D. Stramonium*, *lævis*, and *ferox* belong to the white-

flowered group, while *D. tatula*, *quercifolia*, and some others, bear purple flowers. *D. lævis* and *D. ferox* will hybridise reciprocally, and in 1863 M. Naudin raised 60 individuals of *D. lævi-ferox*, and 70 of *D. feroci-lævis*. The offspring of this reciprocal cross attained "the most complete development, and were so perfectly like each other that the two sets might easily have been regarded as one." "This is a new confirmation of what I have already announced (see 'Comptes Rendus de l'Acad. des Sciences,' 1862), that there is not a sensible difference between reciprocal hybrids of two species, and that in the first generation the hybrids of the same origin resemble each other as much as individuals of pure species from the same sowing." "But these 130 hybrids presented a fact which was quite new to me: if they perfectly resembled each other, they differed strangely from the two species from which they were derived. They had neither the stature, the habit, the flowers, nor the fruit of their parents; there was not even anything intermediate between their forms, which were so well known and so decided. Any one who did not know the origin of these hybrids would not have hesitated to make a new species of them, and, what is worth notice, would have classed them in the violet series, for all had the flowers of this colour and brown stems. Notwithstanding, as I said above, the two parent species belong to the group characterised by green stems and white flowers.

"In the face of this unexpected result, one might have been tempted to believe that two species, intermarrying, might impart to their progeny characters which they do not possess themselves; but such a conclusion was too paradoxical to be accepted without a re-examination. I resolved, therefore, to recommence the experiment the following year, observing at the same time more closely, not only the hybrids, but also the species from whence they were derived. In 1864 I again sowed *D. lævi-ferox* and *feroci-lævis*, and by their side the parents, *D. ferox* and *D. lævis*, in a state of purity. 36 new plants of *D. lævi-ferox*, and 39 of *D. feroci-lævis*, reproduced all the identical features of their brethren of the preceding year. They had the same brown stems, the violet flowers, and thorny fruit. But what I had not previously remarked in *D. ferox* of a pure strain, the stem at the moment of germination is of a deep purplish violet. This vivid tint extends from the root to the cotyledons, where it suddenly ceases, giving place to the clear green tint; but it remains during the whole existence of the plant on the part which it occupies, and where it traces a coloured circle. From this moment all was clear: if

the hybrids of *D. ferox*, allied to another species of the white group, have brown stems and violet blossoms, it is because *D. ferox* itself possesses the germ of this colouring. In the pure species the colouring remains in a rudimentary state, occupying only the small interval which extends from the commencement of the root to the cotyledons; in the hybrid it acquires an enormous increase, extending over all parts of the plant, and manifesting more especially its action on the flower.* Here, then, is a first mode of variation, induced by the crossing of two species, and which produces its effects on the first hybrid generation. The second generation is about to offer us variations of another kind, and still more remarkable. All these hybrids, though sterile at the first seven or eight dichotomies, were very fertile in those which developed later. Their seeds, sown in the spring of 1875, gave me in the second generation 19 plants of *D. feroci-lævis*, and 26 of *D. lævi-ferox*. The two sets still resembled each other, but by a character diametrically opposite to that which was the prominent trait of the preceding generation. The most astonishing diversity of feature succeeded the former great uniformity—a diversity of such an extent that, out of the 45 plants of which the two sets were composed, no two were found which precisely resembled each other. They differed in stature (in the proportion of one to four), in habit, in the form of the leaves, the colouring of the stem and flowers, the degree of fertility, the size of the fruit, and the degree of aculeation. With the exception of a single individual of the *D. lævi-ferox* set, which had completely reverted to *D. lævis*—with this slight difference, that there was still at the base of the stem a circle of purplish violet—not one of these hybrids had sensibly approached this species, and there was only a very small number in which one could recognise faint resemblances to *D. ferox;* the greater part even more closely resembled *D. Stramonium* and *D. quercifolia*, with which they had no more relationship than the species from which they descended. Some had white flowers and green stems, either self-coloured or tinted with purple at the base, while others had violet flowers of various shades, and stems more or less brown, sometimes even of a purplish black, as deep as that of *D. tatula*, which is the most perfect type of the violet group. The fruit was of all sizes, from that of a filbert to that of a large walnut, and some of them were very spiny,

* In hybrid Hellebores the same variable distribution of colouring matter is observable, also in the common Balsam; and, as gardeners are well aware, red or crimson varieties of *Primula sinensis* may be distinguished from white-flowered plants by the colour of the petioles.

while others were covered with tubercles, or almost destitute of spines: certain individuals bore fruit at the first fork, while others were fertile only towards the last, and finally there were some which set only a single fruit. On the whole, the 45 plants of the two sets constituted, so to speak, as many individual varieties as if, the bond which ought to unite them to the specific types being broken, their vegetation had wandered in every direction."

The shrubby or arboreous section of Datura is now referred to *Brugmansia*, and, seeing what diverse results have been attained by intercrossing the annual species, it would be interesting to know what we may expect by intercrossing such noble plants as *Brugmansia arborea*, *B. suaveolens*, *B. arbuscula*, *B. floribunda*, *B. lutea*, *B. sanguinea*, and other kinds.

Franciscea (*Franciseas*).—A small group of purple or lilac flowered Brazilian shrubs, closely allied to *Brunsfelsia*, and represented in our gardens by *F. calycina*, *F. confertifolia*, and one or two other species. They are readily propagated by cuttings of the young growth, inserted in a humid bottom-heat in a close case. Some of the new varieties succeed well grafted on cuttings of the common free-growing kinds as stocks, and this operation is best performed in the spring in a close-heated propagating case. Side splice-grafting is the best method. Seeds are rarely produced unless the flowers are carefully cross-fertilised. Messrs E. G. Henderson have distributed the following free-blooming hybrids:—

Franciscea rosea perfecta.—A beautiful hybrid variety in the large-flowered evergreen group intermediate between *F. Lindeni* and *F. eximia*, being a great improvement upon, both in its much more stately growth and its much finer, laurel-like, oblong, lanceolate leaves, tinted with bronzy red in their first expansion, passing into a bright glossy verdure, and finally merging into a rich green. Its large and finely-formed well-expanded flowers, with converging lobes, are from two to three inches in width, of a rich deep lilac flushed with rose.

Franciscea magnifica.—This is intermediate between *F. eximia* and *F. calycina.* Its comparatively large, laurel-like, oblong, lanceolate, wavy-margined leaves partake of the latter in habit, whilst the remarkably large, rich, lilac, salver-shaped blossoms assimilate to the former, but, being nearly double the size of *F. eximia* in bloom, prove the greater beauty of the plant.

Franciscea violacea grandiflora.—This is an equally fine hybrid production between *F. calycina* and *F. laurifolia*, forming a very vigorous evergreen-leaved stove shrub, with elliptically oblong leaves less wavy or glossy than the preceding

one, but equally free and robust in growth, producing its large, rich, dark, purplish-lilac, salver-shaped flowers in the early spring and summer months.

Nicotiana (*Tobacco*).—The Tobacco of commerce is derived from several species of sticky-leaved herbaceous plants or annuals, mostly natives of tropical America and Eastern Asia. Among those most generally cultivated, that which furnishes the largest quantity of "weed" is *N. tabacum*, or *N. virginica* as it is also called, this being largely cultivated in the Southern American States, and also in China, Holland, Germany, and S. France, Italy, and Spain. *N. rustica*, a dwarfer and hardier species, is grown in the East Indian islands, and furnishes the Latakia and Turkish Tobacco of commerce. It is dwarfer, and grows and ripens more quickly, than the large-leaved kind. There are many other species, and in this country the large-leaved kinds have lately been much used in subtropical gardening. All the species are cultivated as annuals, and are most readily propagated by seeds sown in a gentle heat in the spring. Many of the species may be hybridised with facility, as demonstrated by Gaertner and others. *N. rustica*, fertilised by pollen of *N. paniculata*, was made to produce two kinds of seeds by "dusting half the stigma with the strange pollen before the expansion of the flower, and the remainder after a lapse of twenty-four hours; and the conditions of the experiment were varied until the pure type seeds of *N. rustica* vanished entirely, and merely the hybrid or bastard type seeds made their appearance." So susceptible, indeed, are the Tobaccos to hybridism, that even three kinds of seeds have been produced by the same plant when fertilised by the pollen of two other species. Here again Gaertner is the experimenter. *N. paniculata* was successively fertilised with pollen of *N. quadrivalvis* and *N. Langsdorfii*, and from the seeds produced by this mixed union three proved to be the pure species (*N. paniculata*), four the hybrid, *N. paniculato-Langsdorfii*, and a single individual *N. paniculato-quadrivalvis*. Gaertner gives full details in his work, from which we learn that pollen of *N. Langsdorfii* will fertilise the following species, but the seeds are produced in a decreasing ratio in the order named: *N. paniculata*, *N. vincæfolia*, *N. suaveolens*, *N. glauca*, and *N. rustica*, though not susceptible itself of being fecundated by these species, neither by *N. chinensis*, *N. macrophylla*, *N. quadrivalvis*, and *N. glutinosa*. Gaertner, who experimented largely with the species of this genus, remarks that the want of perfect reciprocity of sexual force, even in the most nearly allied species, shows that the male and female procreative energy do not

keep an equal pace with each other, though this difference has no influence on the typical form of the hybrids which arise from the union. Still, the shorter or longer period necessary for the transformation of one pure species into another by hybrid fecundation seems to depend in some measure on this difference.

When two species, such as *Nicotiana rustica* and *glutinosa*, do not admit of union with one another, or, as *N. paniculata* and *tabacum*, only of imperfect union, the union may be accomplished sometimes by a third species which stands in close elective affinity with either of the first. Thus *Nicotiana rustico-paniculata* is completely fructified by the pollen of *glutinosa*, as also *paniculato-rustica* by that of *tabacum*. This affinity is called by the author compensating or mediate affinity. The pecularity in these unions is, that the consequent hybrids are generally so like the type of the compensating species that they can be considered merely as varieties of this latter which furnished the fecundating pollen, and are for the most part perfectly barren.

Nierembergia.—A small but elegant-habited genus of half-hardy American annuals or perennials, easily propagated from spring-sown seeds. *N. gracilis*, *N. rivularis*, and others, are well known in gardens.

N. gracilis picta is a hybrid and improvement upon *N. gracilis*, being intermediate between that and *N. frutescens*, having the green branching and profuse-flowering habit of the former, with a stronger constitution; the flowers of a blue tint margined with white.

Petunia (*Petunias*).—A small ornamental genus of South American plants, represented in our greenhouses by *P. violacea*, a rather elegant-habited purple-flowered plant, and *P. nyctaginiflora* (see 'Bot. Mag.,' t. 2552), a white-flowered species having large, oblong, opposite, viscid leaves. Seeds grow readily sown in heat like Calceolarias, and good varieties may be perpetuated by cuttings. Both plants hybridise very freely, and their offspring are characterised by a wonderful variability in habit and colour. M. Naudin (see 'Jour. Royal Hort. Soc.,' 1866, p. 6) remarks that these two species are perfectly well defined, neither varying from seed, but intercrossing easily and yielding hybrids as fertile as themselves. "In the first generation all the hybrids are alike; in the second (see *Datura*), they vary in the most remarkable degree, some reverting to the white species, others to the purple, and a large residue showing all the shades between the two. When these varieties are fecundated artificially by each other, as is the

practice of some florists, we obtain a third generation still more party-coloured; and continuing the process, we arrive at extreme variations, sometimes at monsters, which the prevailing fashion regards as so many marks of perfection. The essential point is that these varieties are purely individual and without any natural persistence. Their seeds when sown yield new forms, which have no greater resemblance amongst each other than they have to the plants which produced them."

Solanum.—A large genus of annual or perennial plants, natives of Europe and Asia, but principally of tropical America, whence we obtain the Potato. The fruit of the Egg-plant, *S. ovigerum*, is sometimes cooked as a vegetable, and is a tropical annual easily raised from seed sown in heat in the spring. *S.* (*Lycopersicum*) *esculentum* is the Tomato, or Love-apple, and is now becoming popular as a wholesome esculent in this country. It also is an annual plant from South America, and is raised from seeds in heat like the last. There are numerous seminal varieties which have been raised in America, as well as in this country. Cuttings taken off in summer (July or August) root freely in sandy soil or sawdust in bottom-heat, and if potted in loam, leaf-mould, and sand, and placed on a sunny shelf in a Pine-pit or vinery, will bear fruit very early in the spring. Many species are now extensively grown in gardens for sub-tropical gardening, and those which bear fruit may be readily propagated by sowing the seeds in heat. Cuttings obtained from old plants potted in autumn, and placed in heat, strike readily; and the fleshy roots of nearly all the varieties and species, cut into lengths of about an inch, and sown in pans of light earth, and placed on a gentle bottom-heat of 70° to 80°, root freely, develop latent buds, and soon form plants. The shrubby kinds—as *S. pseudo-capsicum*, *S. capsicastrum*, and their numerous varieties—are readily propagated by seeds sown in the spring (February) in heat, after which the young plants may be plunged out in the open border to make their growth, being taken up again in September. Cuttings of old plants, headed down and placed in heat, also root freely in a heated case, or placed on a gentle bottom-heat and covered with a bell-glass. The variegated form of *S. capsicastrum* may be grafted on *S. pseudo-capsicum* as a stock; herbaceous scions, with two or three leaves, take well, and the operation is best conducted in a close heated case. In 1874 Messrs E. G. Henderson & Sons introduced a new conical-fruited variety, which originated by chance in a batch of seedlings, and yet comes true from seed. It is quite as beautiful as the large round-

fruited dwarf varieties (Weatherill's strain) sent out previously by Mr B. S. Williams.

The Potato (*Solanum tuberosum*) is easily raised from seed; and any variety which grows and flowers freely may be selected as the seed-bearing plant, but preference should always be given to those kinds which produce good, well-formed tubers, with shallow eyes, and which are floury and delicate in flavour when cooked. Let the same qualities characterise the pollen-bearing parent. Mr Fenn, who has raised numerous fine seedling Potatoes, recommends the selection of a vigorous pollen-parent in order to secure good-constitutioned offspring; and he removes the anthers from the seed-bearing plant in the evening rather late, and applies the pollen from a flower of the selected pollen-parent in the morning. The Potato is protogynous—that is, it develops its stigma before the anthers of the same flower discharge their pollen; so that by adopting Mr Fenn's method there is little danger of the stigma becoming fertilised, except artificially. When the Potato-apples or fruits are ripe, cut them open, and dry the seeds in a cloth, as recommended for Melons. February is the best time for sowing the seeds in pans of rich earth, giving them the assistance of a little bottom-heat. When the young plants are large enough to handle, prick them off on to a common dung-bed, covered with three to four inches of rich soil, and protected with a frame. Treated in this way, fair-sized sets may be obtained the second year from seed. Another plan is to prick off the seedlings into pans or boxes, and plant them out in May in trenches, so that they can be sheltered with mats or straw frames in cold or frosty weather. It is best to try each new variety a year or two after good tubers are obtained before discarding it altogether. Potatoes are readily propagated by dividing the tubers so as to have an eye or bud to each portion, a plan which succeeds well, especially with the robust-growing American varieties. Another plan of propagating is to layer the haulm in light rich soil by pegging, and the stems so treated root readily, and throw out numerous tubers. If this operation is carefully performed early in the season, the supply of tubers of new or select varieties for seed purposes can be largely increased. By cutting the tubers up carefully into single-eyed sets very large crops have been obtained from, say, one pound of seed Potatoes—some of the American varieties, as Snowflake, Eureka, and others, being remarkably prolific. In 1875, Mr Pink, gardener at Lees Court, Faversham, dug upwards of 647 lb. of Eureka from 1 lb. of seed, and 372½ lb. of Snowflake from a like amount. Some years ago several Potato-growers

asserted that it was possible to obtain Potato hybrids by grafting the tubers of two distinct varieties together. At the time this was thought by some eminent botanists and horticulturists to be impossible; but when we note the changes effected in the growth of the stock by buds and grafts worked on it in the case of *Laburnum*, *Jasminum*, *Abutilon*, and *Castanea* (see p. 60), to say nothing of the undisputed influence of the stock on the scion, one can the more readily believe that graft hybrids in the case of the Potato are not only possible, but highly probable, although one would also expect the same thing to occur in the case of Dahlias and Hollyhocks, which are not unfrequently grafted in a similar manner.

Mr Taylor, of Fencote, states that the variety called Yorkshire Hero was raised by Mr Almond, by grafting eyes of the Lapstone kidney into an Ashtop kidney, and that he himself has raised Yorkshire Hybrid and others by a similar process. The following is his mode of operation: Two sound Potatoes of different varieties, whose good qualities it is desired to blend, are selected. From one of them all the eyes are first to be cut out with a sharp knife, and then a piece of the tuber in the form of a wedge or some other convenient shape, this being replaced by a scion of similar shape from the other tuber: the scion should have a good eye or two, nicely sprouted, about half an inch long. The two must be tied firmly together with a piece of bast or string, a couple of lady's hair-pins being first run clean through both Potatoes to prevent the tie from slipping off, as well as to assist in holding them together. The fit must be a good one, and the rinds of each must meet, as in grafting other plants. The operation must be performed quickly, and the grafted set must be planted as soon as possible. It is best to have the trench opened and manured ready to receive the grafted tubers, and to place them therein and cover them with soil as quickly as possible. Some of the grafts may fail, so that it is best to graft a dozen or more. They will produce rounds and kidneys, pink-eyed and mottled, purples and reds, of various shapes and sizes, some early, some late, some large, some small, according to the kinds which are grafted. All the produce, large and small, must be planted the following year, for until the tubers have been grown it cannot be told whether the varieties are early or late. The early ones are easily discovered by the early decay of the foliage. The produce of such as look promising by their shape and general appearance should be saved and grown for a year or two until their good or bad qualities are thoroughly proved.

Mr Fenn, of Woodstock, describes some results obtained by

grafting in the 'Jour. Hort. Soc.' (new series), ii. 85, from which we quote the following: "I grafted this year Red Ashleaf on Dickson's Premier, Paterson's Scotch Blue on Royal Albert, and *vice versâ*. I have been unfortunate this season in regard to the taking of the grafts. I planted and kept the grafted sets in six-inch pots, contrary to my later practice of planting them in the open ground when the shoots in the pots have pushed five or six inches out of the soil. This may have tended to cause non-success as regards the cicatrisation of the skins; nevertheless sufficient results have been arrived at to afford conclusive evidence as to the possibility of grafting one Potato with the eye of another. On July 14 I examined two sets—an eye of Royal Albert (a handsome round, white potato) grafted on Paterson's Scotch Blue. The eye had held perfectly fast to the tuber, giving hope of some influence being exerted between the stock and the graft. I made the graft fit as perfectly as possible into the wedge-shaped cavity in the tuber; but at the above date the graft had swelled out of its first position, though not sufficiently so to disunite itself from the cicatrix of its own skin and that of the stock on one side. I gave several good tugs at the graft, but could not displace it; and I sent it to Dr Masters for verification. Dr Masters wrote: 'In one case the cohesion was evident; but I do not see that the new tuber or haulm is at all affected. We must have more conclusive evidence. I see the union is not merely along the rinds, but in the cellular mass of the Potato as well. I have forwarded the tubers to Chiswick. The whole subject is very interesting.'

"The other sort sent to Dr Masters was the eye of a Paterson's Scotch Blue grafted on Royal Albert. No cicatrix or union of the skins had been formed; but some of the young tubers were half-coloured, others less coloured, and one was perfectly white, none of them showing blue all over like the grafted sort."

Professor Regel of St Petersburg, and M. Bouché of Berlin, both made experiments in Potato-grafting, but failed to obtain any results of a satisfactory nature, no change being effected except such as might be attributed to reversion. Darwin, however, has collected most of the information on this subject in his 'Animals and Plants,' i. 422, from which we learn that in the Royal Gardens at Berlin numerous experiments were made by Herren Reuter and Lindemuth, who inserted the eyes of red Potatoes into white ones, and *vice versâ*, many different forms, partaking of the characters of the united varieties, being the result. Dr Neubert and Mr Fitzpatrick

also obtained very variable intermediate varieties by grafting the stems (haulm) of two distinct varieties together. Those between black and white, as red varieties, were the most distinct, some of the tubers obtained by grafting the white and red varieties being half red, and half white on the same tuber.

Solanum capsicastrum hybridum is a free-growing, berry-bearing hybrid obtained by Mr M'Intosh. It is the result of crossing *S. capsicastrum* with the more erect-growing *S. pseudo-capsicum* (see 'Proc. R. H. S.,' vol. iv.)

Mr Maule, of Bristol, succeeded in grafting branches of *Solanum nigrum* and *S. dulcamara*, well-known garden weeds, on to the stems of the Potato, his object being to "infuse a hardier constitution into the Potato, and so enable it to resist disease." *S. nigrum* and *S. dulcamara* both resist the Potato-disease; but they are poisonous plants, and we see but little prospect of this experiment leading to any practical and useful end. Mr Maule's experiment was brought into notice before the Scientific Committee of the Royal Horticultural Society, Nov. 10, 1875; and, curiously enough, in the 'Gardeners' Journal,' 1847, p. 85, is an account (derived from Transatlantic sources) of grafting the Tomato on the stem of the Potato, which is said to be successful, both Tomatoes and Potatoes having resulted from the union. Mr A. Dean, of Bedfont, exhibited a bushy plant of a Potato in 1876 which had been grafted on a Tomato stock; and the Potato haulm being thus elevated above the earth, it produced tubers abundantly in the axils of its leaves.

THE INDIAN CRESS OR NASTURTIUM FAMILY (*Tropæolaceæ.*)

A small order of trailing annual, herbaceous, or perennial plants, nearly all being natives of the temperate regions of North and South America. Among the best-known species are the following: *T. majus* (Common Nasturtium), a Peruvian annual, long cultivated in our gardens (see 'Bot. Mag.,' t. 23), *T. tuberosum*, *T. speciosum*, *T. tricolorum*, *T. azureum*, *T. pentaphyllum*, and *T. perigrinum* (Canary Creeper). The properties of the order are antiscorbutic, and greatly resemble those of many Crucifers; and, curiously enough, M. de Candolle points out the fact that the caterpillar of the cabbage white butterfly feeds exclusively on Crucifers and *Tropæolum*. The anthers of *Tropæolum* are mounted on long and short filaments, and discharge their pollen in succession, each bending in towards the style in its turn, as has been observed

by Mr John Duncan in some species of Saxifrage. The annual species and varieties are readily propagated from seeds; and cuttings taken off in the autumn may be rooted and grown in a sunny stove all the winter, such plants being useful for blooming in the spring. The S. American, tuberous-rooted species, seed occasionally, and the seeds germinate freely in a genial bottom-heat of 65° to 75°, or they may be increased from herbaceous cuttings in heat by carefully grafting or inarching herbaceous cuttings or young growths on bits of the old tubers in a close case, or the old-established plants may be shaken out in the autumn after the foliage has decayed, and the tubers can then be divided. Careful selection has given us numerous dwarf and free-blooming forms of *T. majus*, and some of the other species are doubtless capable of improvement in the hands of a skilful hybridist.

T. Lobbii, *T. majus*, and *T. Moritzianum* have produced numerous hybrid forms, and a great number of beautiful hybrids have long been known between *T. Lobbii* and *T. Smithii*. The following hybrids were known in French gardens ten years ago: *T.* Louise Keller, *T. massiliensis*, *T. Triomphe du Prado*, *T. zandeir-grandiflorum*, *T. zipseri*, *T. zipseri-majus*, and *T. Chaixianum*. A new variety of *T. majus* was raised a few years ago by Mr Miles of Cressingham, this being known as *T. Milesianum*, Hort., and it deserves notice, being perfectly hardy, having glaucous foliage, and vivid scarlet or orange-red flowers 1½ inch across.

T. canariense improved or *T. fragrans* (Barr and Sugden) is a hybrid between *T. canariense* and *T. majus*, var. "Napoleon III." partaking of the colour, shape, and freeness of the former, so well known in every garden as a climber. Many attempts have been made hitherto to cross it with other species without success. The colour bright yellow, with a deep crimson heart-shaped spot on each segment of the flower, deeply and beautifully fringed or scalloped. It was sent out in 1873.

The Camellia and Tea Family (*Ternstromiaceæ*).

A small order of evergreen plants, principally natives of China, Japan, and N. India, the principal representatives in our gardens being the numerous forms of *Camellia*. The Tea-plant, which has done so much to found the commercial prosperity of China, also belongs to this order; and *Thea bohea*, a pretty evergreen shrub, is not unfrequently met with in gardens, where it is grown as a curiosity. Its flowers are

white, and scarcely the size of a shilling, being in form like a small single *Camellia*. The different forms of prepared tea, as sold in our shops, seem to depend on the methods of preparation, or on the age of the leaf when gathered, rather than on different kinds of the Tea-plant.

Camellia.*—This is one of the most variable and beautiful of all our winter-blooming greenhouse plants, several species being grown in our gardens, but most of the varieties are "sports," seminal or hybrid forms of *C. japonica*, which appears to have been introduced in 1739. *C. oleifera*, from the seeds of which an excellent oil is extracted by the Chinese, was introduced in 1819. *C. maliflora* (1818), and *C. sasanqua*, a small-leaved species (of which there are double white and double and semi-double red and variegated varieties), are now referred to *Thea*. The last is a very pretty plant indeed, a Pompone *Camellia*, from which the hybridiser might do worse than raise a race of bushy-habited plants, with flowers little larger than a shilling—the flowers of the ordinary varieties being too large for button-holes, and adding a heavy appearance to bouquets if too freely used.

C. reticulata, introduced in 1824, is by some thought to be a distinct species, but is probably a distinct form of *C. japonica*. It is singular to observe that a perfectly single or normal flower of *C. japonica* is very rarely to be met with, which is much to be regretted, for the single white when perfect is one of the loveliest of all flowers, even more beautiful—that is, whiter and more perfect in form—than *Rosa bracteata* or *R. rugosa alba*. Hybridisers, in attempting to raise single-flowered forms, should select parent plants which bear the most perfect—*i.e.*, normal—single flowers; and the pollen should be selected from those stamens which are free—that is, not fused into irregular bundles, as is generally the case. In raising double-flowered varieties, select a seed-bearing plant which bears flowers showing a strong tendency to become double, and procure pollen from the best-developed anthers, which are found on the edges of the petals or petaloid filaments of a double-flowered variety. The late Dean Herbert, in 1837, recommends that the seed-bearing plants should be kept rather close, and receive a superabundance of moisture at the root. Young shoots should be pinched in or shortened so as to divert the whole nutriment of the plant, or as much as is possible, to the seed-vessels. "I have no difficulty in ob-

* For a synopsis of the genus Camellia, see 'Trans. Linn. Soc.,' xxii. 337. Camellia fruits and seeds are well figured in 'Gard. Chron.,' 1873, p. 1733.

taining seeds from any variety of the Pompone or Middlemist's *Camellia*, by putting it in a house rather warmer and with less ventilation than suits greenhouse plants in general, impregnating the stigma, and cutting off the corolla before it begins to decay, so that the air may have free admission to it, without which precaution it will perish in most cases from damp." The late Dean Herbert raised numerous varieties of large and small flowered or Pompone *Camellias*, for a list of which and their pedigree see his 'Amaryllidaceæ,' p. 367. This author observes that "there is a strange mutability in the flowering (sporting) of *Camellias*," a fact which Chinese, Italian, French, and Belgian raisers have long turned to good account by grafting the sports or reversions when distinct on common red or white seedling stocks, and distributing them as new sorts. Mr Chandler and Mr Gray also raised numerous seedlings, and others were sent out from Colville's nursery. In America, Marshal P. Wilder has raised seedling *Camellias*, and he thus writes on the subject (see 'Gard. Chron.,' 1873, p. 575): "In my experiments I have discovered that for the production of double flowers it is important that the pollen used for impregnation should be borne on a petaloid anther—that is, an anther bearing a small petal—and that this is still better if from a double flower. I have also observed that the larger and better developed this petaloid anther, the better the chance for a fine double offspring; for, as might have been expected, the anthers being connected with the corolla, the number of petals would be increased by such an operation. I found also that for the most perfect and symmetrical flowers it was better to select single flowers which were the most perfect in their petals for seed-bearers, and that single or semi-double sorts with perfect corollas, when impregnated with "petaloid" pollen, will produce double flowers of a regular formation. Of this I have the most conclusive evidence in *Camellia Wilderi* and many other fine double varieties in my collection, which were produced from the single red and single white *Camellias* fertilised by pollen from a petaloid anther of double varieties.

Grafting.—All the finest seminal varieties or "sports" are propagated by grafting on stocks of the old single red variety, which is generally planted out in a greenhouse border to supply cuttings for stocks. Cuttings are made of the partly-ripened shoots, inserted in pans or a bed of sandy earth, and covered with a close shade or a hand-light. It is best, however, to place the cuttings firmly in well-drained pans, surfaced with white sand, and to set them in a cool shady frame under a hand-light for two or three weeks; after which place them in a moist

bottom-heat of 75° to 85°, which induces them to root and start into growth very quickly. Pot them off separately into small sixty-sized pots, and set them closely in a moist and partially-shaded case, where they will make a quick growth, and being close together they draw up straight. Cuttings are generally fit for grafting in about a year after they are rooted, and may be worked either by side, cleft, or veneer grafting any time from July to September, or indeed nearly all the year, if the convenience of a heated propagating-pit is at command. Side-grafting is generally adopted, a simple diagonal slit being made downwards an inch or two above the soil, and into this a wedge-shaped scion is inserted. The scions should be formed of partly-hardened young shoots two or four inches in length, the lower leaves being removed. In grafting, do not head off the stock, but make a clean downward cut with one stroke of a keen thin blade; then form the base of the scion by two more clean sloping cuts, and insert its wedge-shaped base into the cleft in the stock, taking care that the alburnum on one side of the stock at least is covered by that of the scion. No tying or mastic is requisite. Lay the grafted plants diagonally in the plunging material at the bottom of a heated case in the propagating-house, and keep them close for three or four weeks, in which time a union will have been made between the plastic tissues, and the parts will appear as if welded together. This is the best, quickest, and simplest method of grafting Camellias, and is generally employed in all good nurseries at home and in Continental gardens. Even cuttings are sometimes worked in this way, and rooted at the same time. Where thick roots of common varieties can be obtained, they may be tried as stocks. After the union is effected, head off the stocks neatly, and grow on the young plants in the usual way. Even shoots set with bloom-buds may be grafted by a clever propagator, and in this manner some pretty miniature blooming plants are to be obtained, each bearing from one to four flowers and about as many leaves, the whole plant being not above six inches in height. M. Bause in 1868 grafted two or three dozen of *C. reticulata* in this way a few weeks before their flower-buds expanded, and these little *bijou* plants were much admired when exhibited at South Kensington. Plants so treated would fetch a good price in Covent Garden, and we recommend some of our intelligent growers of decorative plants to give this plan a trial. If the old single red Camellia is fertilised with pollen from another variety it seeds freely, or seed may be obtained from any of the semi-double forms, and sown as soon as ripe in pans

of light rich earth. These grow away well and form excellent stocks; and, according to some nurserymen and propagators, varieties worked on seedling stocks grow more vigorously and are longer lived than when grafted on cuttings, but we have observed very little difference. Inarching may be adopted when the stock is large and cannot be enclosed in a close case, or for renovating old specimens (see fig.). Cleft-grafting also succeeds well in a close atmosphere.

Inarching Camellia on "planted-out" stock

Thea.* — The Tea-plant, which has been so largely cultivated in China for ages, and of late years also in Assam, is a variable plant—indeed, I know of no plant which has any claim to the title of being cultivated but what is more or less variable, in one way or other, since cultivation is expressly designed and carried out as a means of improving plants in size, form, colour, or flavour. *Thea bohea* (see 'Bot. Mag.,' t. 998) is perhaps the most generally-cultivated species for purposes of tea-making, but some forms of Camellia, as *C. sasanqua*, are also used for the purpose. The numerous varieties of Chinese Tea imported to this country are principally the result of different methods of manufacture, and in some cases depend on the age of the leaf, the tea made from the youngest and earliest leaves being most delicate in flavour. The Tea-plant is freely propagated from seeds, which are readily produced in cultivation in our gardens if artificial fertilisation is resorted to. Cuttings of the young wood also root if inserted in heat, as recommended for Camellias. The Tea-plant grows well if

* For a valuable account of the Tea-plant, see Royle's Illustr., p. 107.

grafted on *C. sasanqua* or other *Camellia* as a stock. It is a dark-green bushy evergreen shrub, which bears pretty little white myrtle-like flowers, and is not unfrequently met with as a curiosity in our gardens.

THE LINDEN FAMILY (*Tiliaceæ*).

A small order of trees and shrubs; a few, however, are dwarf-growing, herbaceous plants, and while the principal members of the group are confined to the tropical parts of both hemispheres, some trees are found in northern and temperate countries. The principal genera in this order found in our gardens are *Sparmannia*, *Tilia*, and *Corchorus*. *Sparmannia africana* is a well-known old greenhouse shrub, having white flowers and numerous sensitive stamens, partly abortive. When irritated, the stamens of this plant gradually expand, the motion being much more energetic in the sunshine than in the shade, just as in the case of the leaves of the Sensitive plant (*Mimosa*). It is also curious to note that the sensitive motion is exactly the reverse of the same phenomenon in *Berberis*, where the stamens contract or close in towards the column. *Corchorus japonicus* is a well-known, golden-flowered, hardy shrub, its double form being especially common in our gardens. *C. capsularis* is cultivated in the tropics, and furnishes the gunny-fibre of commerce, vast quantities of this material being now manufactured in London. The Linden-tree (*Tilia europæa*) and its fastigiate, cut-leaved, and other ornamental forms are much employed in planting garden scenes, and seem to have been appreciated as a landscape ornament at an early date; and some of the finest avenues in existence, as at Burghley and Hampton Court, are planted with Limes. We have several selected "sports" from the different species of *Tilia* in cultivation, some of the variegated forms being very handsome. These are best propagated by budding or grafting on their respective green-leaved or normal types.

THE DAPHNE FAMILY (*Thymelaceæ*).

A small group of shrubs, characterised by their tenacious bark: indeed, in Nepal, the natives prepare a peculiar soft bibulous paper from the bark of *Daphne bholua*, and *D. cannabina* is used for a similar purpose by the Chinese, and the beautiful lace-bark is prepared from *Lagetta lintearia*. They

are principally natives of North India, South America, the Cape, and also of New Holland, while a few are European. The principal genera grown in our gardens are *Daphne Mezereum*, *Pimelia*, and one or two others. Many of the plants in this group bear berries, which germinate freely sown in a gentle heat, or the hardy species in pans or boxes in a cold frame or pit. Cuttings of the young or partially-ripened wood are also successful.

Daphne.—A genus of deciduous or evergreen shrubs, principally natives of Southern Europe, India, China, and Japan. The varieties of *D. indica* and *D. cneorum* are favourites, their flowers being deliciously fragrant. All the tender species may be propagated from cuttings taken off either in spring or autumn and inserted in well-drained pots of sandy soil. Side branches, an inch or two long, are best. The hardy kinds may be propagated by layering, and some, as *D. Mezereum* and the common British Spurge Laurel, *D. Laureola*, from seeds, which are freely produced. Seedlings of the last-named species are generally used as stocks on which to graft the tender and more valuable stove or greenhouse kinds. The seeds of *D. Laureola* take two years to vegetate, so that cuttings or layers are more expeditious. Stocks for grafting, no matter whether of *D. Laureola* or *D. pontica* (which some propagators prefer), may be established in pots. Graft in heat in the winter or spring, and introduce the stocks and plants from which the scions are to be taken into heat a week or two before the operation takes place. A young shoot, 2—3 inches in length, is selected for a scion, the lower leaves being removed. Side and splice grafting are the methods generally adopted. Do not head down the stocks entirely until after the scions have taken. Side-grafting in a close case, with the pots plunged in a genial bottom-heat, is best, and do not use too much tying material; indeed, a clever manipulator discards it altogether in the case of Daphnes, Gardenias, Ixoras, and Camellias; and when a moist genial heat is kept up regularly, it is not required. Care must be taken, however, that the scions are not displaced in watering or syringing. There are several hybrid Daphnes in cultivation and several seminal varieties, some of the dwarf bushy kinds being very beautiful hardy shrubs. It does not appear to be generally known that cuttings of all Daphnes succeed perfectly if grafted in a close-heated case on pieces of their own roots. In the case of the choice and tender varieties, roots of the commoner species, such as *D. Laureola*, or better still, *D. pontica*, are preferable for many practical reasons, and give better results. In Devon, Cornwall, and other mild southern

counties, *D.* (*odora*) *indica* is perfectly hardy, and may be grafted on established plants of the Common Spurge (*D. Laureola*), which readily propagates itself from seed.

D. Delahayi is an interesting hybrid, raised in 1827 by M. Fion, its parents being *D. collina* fertilised with pollen of *D. cneorum*. M. Fion also raised a hybrid, *D.* "Dauphin," its parents being *D. collina* fertilised with the pollen of *D. odora*.

Other beautiful hybrids are *D. neapolitana* (*D. australis* × *D. oleoides*), *D. Fioniana* (*D. collina* × *D. oleoides*), *D. collina-axillaris* (*D. Mezereum* × *D. collina*). *D. hybrida* (*D. odora* × *D. collina*) closely resembles *D.* "Dauphin," and was raised by M. Fion from the same parents some time about 1822.

The Carrot and Celery Family (*Umbelliferæ*).

A large group of herbaceous plants, mostly having hollow-furrowed stems, and often milky. They are principally natives of northern or temperate countries, and especially of Europe, North Asia, North America, and the Himalayas. Many of the species are medicinal, several are valuable food-plants, while others are dangerous poisons. The principal genera in cultivation are: *Hydrocotyle*, *Eryngium*, *Cicuta*, *Apium* (Parsley), *Fœniculum* (Fennel), *Angelica* (Angelica Root), *Ferula*, *Heracleum*, *Daucus* (Carrot), and many others. Celery, Parsley, Carrots, Parsnips, Angelica, Fennel, and one or two other kitchen-garden products, are too well known to need description, and are nearly all selected cultural forms of native wildings, with the improvement of which hybridism has had but little to do. Several North American Umbellifers, natives of Oregon, and there popularly known as "Biscuit Roots," are edible, and might possibly be worth introduction to our gardens. Seeds are freely produced, and germinate readily sown in April or May in shallow drills.

Apium (*Celery and Parsley*).—Wild Celery (*Apium graveolens*) is a native marsh-plant, generally found near the sea, and although poisonous in its wild state, becomes a delicious vegetable when cultivated and blanched. A cultural form of this plant is known as Celeriac or Turnip-rooted Celery, and is much used on the Continent in salads and soups. The cultivated Celery of our gardens is very variable, numerous red and white stalked forms being known. *A.* (*Petroselinum*) *sativum* is the Common Parsley, one of the freshest and greenest of all our kitchen-garden herbs, and was introduced from Sardinia in 1548. Hamburg Parsley has fusiform roots, which are sliced

for soups. Several forms of the Common Parsley have been obtained by careful selection.

Daucus (*Carrot*).—The Carrot appears to have been introduced into this country by the Dutch about 1558 in a cultivated state, but it has been long known by the ancients. Pliny tells us the best were brought to Rome from Candia. This crop is easily raised from seeds sown in March or April, or in August for a winter crop. The seeds are fringed with curled or hooked hairs; and to prevent them sticking together and coming up unevenly in the drills, rub them well together with dry sand, earth, or ashes previous to sowing. For seed, plant the finest and cleanest roots, and thin out the umbels when in flower.

Miller, the celebrated gardener at Chelsea, and M. Decaisne, both failed in their efforts to improve the wild inland form of *Daucus carota* by culture and selection. In 1860, however, Prof. Buckman (see 'Sc. and Prac. of Farm Cult.,' p. 11) "gathered some seeds of the seaside form (*D. carota*, var. *maritima*) at Bognor, which, on being sown in a prepared plot the following spring, resulted in fairly succulent roots, which on being cooked were pronounced to be excellent. While on this subject, it may be mentioned as not a little remarkable that so many of our garden esculents should be derived from seaside plants. Thus probably Carrot, but certainly Celery, Seakale, Asparagus, and Cabbage. This would seem to point to the fact that cultivation requires a complete change of the circumstances necessary to maintain a wild condition; and hence cultivated plants can only be kept up by the labours of a cultivator." This last statement not only shows us how valuable a complete change of soil and atmosphere is to cultivated plants, but also leads one to inquire whether valuable varieties of vegetables might not be originated from some of our inland plants by commencing their culture and selection in a maritime locality.

Pastinaca (*Parsnip*).—The Common Parsnip is a native plant, and is also found in Southern Europe. As an esculent, these vegetables have been long known; and according to Pliny, the Emperor Tiberius esteemed them so highly that he had them brought to Rome annually from the banks of the Rhine, where they were at that date cultivated.

In 1847, Prof. Buckman gathered seeds of the wild Parsnip from the Cotswold Hills, where it is one of the most frequent of weeds; and after cultivation and selection for five years, the result was a new esculent variety, now known as the "Student or Hollow-Crowned Parsnip" of gardens.

The Elm Family (*Ulmaceæ*).

Trees or shrubs, principally natives of North Asia, Europe, India, China, and North America, and represented in our gardens by different species of *Ulmus* (Elms), *Celtis* (Sugar-berry), and *Planera*. Propagated by seeds when procurable, or by layers. The weeping, golden-leaved, and variegated varieties of Elm are grafted on the common green-leaved species as a stock. The Planeras also do well grafted on the Common Elm.

From the 'Gardener' (1871) we learn that in Lord Petrie's Park, Thorndon Hall, Essex, some Elm-trees are growing which have been grafted on Hornbeam stocks (*Carpinus*). If this is correct, which we cannot help doubting, it is the first instance of grafting having been successful between two different natural orders. It appears that, "according to the observations of Dr Bull" (in the 'Florist'), "the English Elm, in ordinary Herefordshire soil, grows more rapidly than that most vigorous-growing of all the varieties of the Wych Elm, the Chichester Elm—a tree that in suitable soil will often make shoots of from six feet to ten feet long in a single year." The experiment, he says, has been made. "Some say that the English Elm won't grow well; but the fact is, they are sent out grafted on the Mountain or Wych Elm. So long as the tree is planted in the rich loamy soil so prevalent in nurseries, the advantage is undeniable,—a larger tree is grown in a shorter time and equally good; but remove it to the ordinary stiff clay loam of Herefordshire, and the Wych Elm will not thrive. The conclusion is evident: plant English Elms on their own hardy roots."

Ulmus berardi is a very remarkable and distinct variety of the Common Elm (*Ulmus campestris*), raised in 1865 by MM. Simon-Louis of Metz. It forms a very bushy shrub, with very slender branchlets, and in its foliage exactly resembles *Comptonia asplenifolia*. The leaves are of a very dark green, almost black, very small, and irregularly crenated, like those of *Planera crenata*, and usually stand erect on the branches, which they almost entirely hide from view.

The Cranberry Family (*Vacciniaceæ*).

A group of shrubs or small trees, frequently evergreen, and principally valuable for the sake of their edible fruits. They

are mostly found in swamps, marshes, and sub-alpine districts in temperate parts of the world, and especially in North and South America, Europe, and Asia. They are represented in cultivation by *Oxycoccos* and *Vaccinium* (Whortleberries); while several species of *Oxycoccos* and *Vaccinium* are grown in swampy ground in North America, and the fruit canned and exported as "Cranberries." The berries of our native *V. uliginosum* are said to be narcotic, and to be used for rendering beer and porter more heady or intoxicating.

In 'Science Gossip,' November 1872, is an account of a curious British plant, supposed to be a hybrid between *Vaccinium myrtillus*, which it resembles in time of flowering, flower, and fruit—and *V. vitis-idæus*, which it resembles in stem, leafage, and habit. The pollen is slightly irregular and shrunken, and there are but few perfect seeds (see 'Jour. of Bot.,' ix. 122).

THE VERBENA FAMILY (*Verbenaceæ*).

A very attractive group of trees, shrubs, or herbaceous plants, common to the tropics of both hemispheres, and found plentifully in South America. They are represented in our gardens by *Verbena*, *Lantana*, *Petrea*, *Callicarpa*, *Clerodendron*, and *Myoporum*. Nearly all the species are readily propagated by cuttings; *Petrea*, however, is an exception. Seeds of *Verbena*, *Lantana*, *Callicarpa*, *Clerodendron*, and *Myoporum* germinate freely, sown as soon as ripe in well-drained pots or pans, and afterwards placed in a heated case to germinate. *Clerodendron Kæmpferi*, *C. fallax*, *C. Balfouri*, and others, are best propagated by seed sown in a pot or pan and plunged in a genial bottom-heat of 75° to 80°.

Clerodendron (*hybridum*) *speciosum* (see 'Revue Hort.,' 1873, p. 471). This showy scarlet-flowered plant is said to be a hybrid between *C. splendens* and *C. Balfouri* or *C. Thompsoni*, and was sent out in 1868 by Mr W. Bull. It is also known as *C. hybridum*, Hort., *C. speciosum Rollisoni*, or simply as *C. Rollisoni*.

Verbena.—A genus of hardy or half-hardy annuals, biennials, or herbaceous plants, represented in our gardens by *V. venosa*, *V. incisa*, and *V. teucroides*. *V. chamædrifolia* was also one of the earlier species from whence our modern varieties originated. All are natives of South America. They are readily propagated by cuttings of the young growth, by seed, or by division. As a florists' flower the Verbena has been much im-

proved by cross-fertilisation, as well as by selecting seed from fine varieties; and some of the finest varieties have been raised by Mr Eckford of Coleshill and Mr Perry of Castle Bromwich. If cross-fertilisation is resorted to, the plants should be grown in pots in an airy greenhouse or cool frame, fully exposed to the sun: fine varieties, however, are raised simply by saving seed from a few carefully-selected varieties. The seeds are best sown in February, in pots or pans of light, rich, sandy earth, and, being small, they require only a slight covering of soil. They germinate in about a week or ten days, and are fit for pricking off into pans in a fortnight or three weeks later. A gentle bottom-heat of 60° to 70° suits both cuttings and seeds.

V. melindra is a dwarf-growing plant, which was much grown twenty-five years ago. Its procumbent growth roots at every joint, and the bright green foliage forms a dense carpet, above which rise little trusses of brilliant scarlet flowers. This kind is still in cultivation, and ought to be invaluable to the hybridiser in improving the habits of more modern and larger-flowered varieties for bedding purposes. *V. incisa*, a red-flowered species, with inciso-dentate foliage, was introduced from Panama in 1836, and *V. teucroides* from Monte Video the year following. This last is sweet-scented, used formerly to be much grown as an ornamental plant in gardens, and, together with *V. melindra* and *V. incisa*, seems to have originated the bedding varieties now so popular, and of which that known as "Purple King" is one of the best. Mr Rumsey of Waltham Cross raised a very beautiful large-flowered variety, named and sent out as *V. odoratissima* in 1876. This had large trusses of bright rosy-lilac flowers, each nearly an inch across, with a conspicuous white eye, and is very distinctly and agreeably perfumed. *Verbena Monetii* is a pretty little plant, from which have originated most of the dwarf-growing, striped, and bordered varieties, either by seminal variation, or its having been hybridised with the irregularly-striped forms of the *V. teucroides*, or large-flowered group, of which *V. striata perfecta* may serve as a type. Some very pretty varieties of *V. Monetii* were raised in 1860 by M. Laloy, a horticulturist of Souhans. This plant might be used for cross-breeding purposes with the common forms, and some very nice fancy flowers thus obtained for pot-culture or for baskets; but for bedding purposes self-coloured forms are best. About ten years ago Mr Wills and others attempted to cross *V. venosa* with the hybrid forms of *V. teucroides* and *V. melindra*, but, I believe, without success.

Verbena montana.—A perennial and perfectly hardy and free-blooming pale rosy-flowered species from the Rocky Moun-

tains, was introduced to Ascot a year or two ago. It roots freely from young tops in heat, like the other varieties. In noting the introduction of this plant in 1873, the editors of the 'Gardeners' Chronicle' (see p. 575) remark: "Crosses made between this new species and *V. venosa* would in all probability produce an interesting progeny, and if it were also used by raisers of seedling Verbenas, for the purpose of restoring something of the lost constitution which has resulted from inter-breeding, the Verbenas might eventually become more popular, or at least better fitted for outdoor purposes in our gardens."

Verbena Lamberti is a strong-growing plant, bearing lilac-purple flowers in dense terminal clusters (see 'Bot. Mag.,' t. 2200). *V. aubletia* is another of the earlier species (see 'Bot. Mag.,' t. 308).

The Violet and Pansy Family (*Violaceæ*).

A small natural group of temperate herbaceous or sub-shrubby evergreen plants, principally natives of Europe and America. *Viola odorata* is one of the best-known examples, and from this wild species we have now a race of very beautiful single and double blue, purple, lilac, and white varieties. The Neapolitan or Naples Violet has long been grown in our gardens for its early-blooming habit, as also has "The Czar." Lee's "Victoria Regina" and "Prince Consort" are even superior to "The Czar" in size and colour, their fragrance being fully equal to the wild species. Ten or twelve years ago *Viola lutea*, a wild Yorkshire species, and the soft lavender purple *V. cornuta* or Horned Violet, were introduced for bedding purposes, and several races of what are known as Bedding Violas have been originated by blending these species with some of the more hardy and strong-constitutioned Pansies. Some of these half-breeds are very beautiful, and possess the valuable property of remaining in bloom for several months. One of the best of the yellow-flowered varieties is *V.* "Sovereign," and *V.* "Blue Perfection" is one of the best of the blue-flowered race. Mr R. Dean, Mr Cannell, Mr Ware, Messrs Downie and Laird, Messrs E. G. Henderson, and other raisers, have assisted in the improvement of the races of Pansies and Bedding Violas. One of the most vigorous of our wild species is the bluish-lilac-flowered Wood Violet, *V. canina*, which blooms most profusely along with the Primrose and Bluebells (*Scilla nutans*) in the spring months. This plant is well worth taking in hand by some intelligent hybridiser; a little cultural care, selection,

and cross-breeding might make it a valuable plant for spring bedding. When we remark the immense improvement effected in the weedy-looking *V. tricolor* of our corn-fields, the amelioration of many other wild European forms appears comparatively easy.

Pansies.—A well-known section of hardy, large-flowered Violas, by some supposed to have originated from the common wild *V. tricolor* of our corn-fields, while others suppose our garden Pansies to have sprung from *V. tricolor* crossed or hybridised with *Viola altaica*, Tartarian Heart's-ease (see 'Bot. Mag.,' t. 1776). The credit of raising the first Pansy is said to be due to Lady Mary Bennet (daughter of one of the Earls of Tankerville) who had a garden at Walton-on-Thames, and with the assistance of her gardener, Mr Richardson, raised the Pansy some time about 1810 or 1812. Pansies are easily reproduced by side-slips or cuttings of the young growth taken off any time during the spring or summer months. They strike freely in the ordinary borders or flower-beds, but require shade in hot weather. Where they are to be propagated in quantity, a cold frame with a northern aspect, or a border behind a north wall, is the best position for them. New forms and colours are raised from seed. Select the best-shaped and richest-coloured varieties as seed-bearing plants. Cuttings of the solid young side-shoots struck in August or September, and planted out in a cold frame, will bloom the following April and May. The earliest flowers—say the first half-dozen borne by each plant—should be carefully impregnated with pollen from other good flowers, using for the purpose a small camel's-hair pencil slightly moistened, so as to hold the pollen readily. Some growers, instead of fertilising the blooms artificially, admit air freely on warm sunny days or save seed from open-air beds, but in either case seed from the earliest and finest flowers only should be saved. Where several varieties are grown in the same frame or bed, they become self-crossed by the wind or by insects, and seeds saved from self-fertilised flowers produce a large number of good flowers, the best of which may be perpetuated for exhibition or decorative purposes by cuttings. These rich-coloured, velvety flowers may be bloomed throughout a great part of the year by striking cuttings at different times: thus autumn-struck cuttings flower in the spring, and spring-struck cuttings bloom in the summer and autumn months. Many of the other Violas might be crossed with these lovely flowers, and in this way something new in colour, habit, &c., might be obtained.

THE GRAPE-VINE FAMILY (*Vitaceæ*).*

A group of rambling shrubs or erect bushes, the woody tissues of which at certain seasons abound in a copious supply of sap. The species are wild in the woods of the milder and tropical climates of both hemispheres, and especially in the E. Indies. The principal genera are *Vitis*, *Cissus*, and *Ampelopsis*. Several species of Vitis abound in America, including *V. vulpina*, *V. æstivalis*, *V. labrusca*, and others. The European cultivated Grape, *V. vinifera*, is supposed to be a native of Asia, and its small-berried, seedless variety is much grown at Corinth, Zante, and other parts of Greece, and imported to this country under the name of "Currants," which is a corruption of Corinth. The value of these depends on their being seedless; and it is said that if cultivated in other warm parts of Europe this variety shows a tendency to produce larger berries containing seeds. The "Sultana" Grape, of the fruit of which raisins are made, is also seedless, as well as a variety called Black Monukka, long grown at Chiswick and elsewhere. The Grape-Vine is one of the earliest cultivated of all our fruits, and the art of wine-making was known at least 6000 years ago. In the tomb of Phtah-hotep, a high functionary who lived at Memphis 4000 years B.C., are scenes in bas-relief representing the gathering of the Grapes, bruising them with the feet, &c.; and, curiously enough, the artist has represented a wine-bibber in a state which leads one to suppose that the ancients did not always drink wine in moderation (see 'Belg. Hort.,' 1872, p. 288). We need not pretend to talk of the deterioration of our modern cultivated fruits, when the bas-reliefs of Egyptian artists speak to us across an awful gulf of five or six thousand years, and show us that our Vine of to-day is much the same as that grown thousands of years before our time.† The American Vines deserve some slight notice here, as they succeed in a severe winter and very trying summer climate, where our European varieties have hitherto failed. There are nine types or species of Grapes found wild in the woods of the

* For a very full and interesting account of American native Vines, and their cultural varieties, hybrids, &c., see "The Illustrated Descriptive Catalogue of American Grape-Vines," published by Bush & Son, of the vineyards and grape-nurseries, Bushberg, Jefferson county, Mo., U.S.A. The species in this valuable work were described and arranged by the late Dr Engelman of St Louis, and a perusal will amply repay the cultivator here at home.

† For a full account of the Vines of N. America, China, and Japan, see Dr Regel's 'Conspectus Speciorum Generis Vitis.'

N. American States, California, and other adjoining countries; and some of these are also found in Asia. Dr Engelman enumerates them as follows:—

1.	*Vitis rupestris*,	Scheele;	The Bush or Sand Grape.
2.	" *cordifolia*,	Michaux;	Winter or Frost Grape.
3.	" *riparia*,	"	Riverside Grape.
4.	" *arizonica*,	Engelman;	Arizona Grape.
5.	" *californica*,	Bentham;	Californian Grape.
6.	" *æstivalis*,	Michaux;	Summer Grape.
7.	" *candicans*,	Engelman;	Mustang or Texan Grape.
8.	" *labrusca*,	Linnæus;	Northern Fox-grape.
9.	" *vulpina*,	"	Southern Fox or Muscadine.

This last-named species is also known as *Vitis rotundifolia*, Michaux, and is strictly confined to the Southern States, while hitherto it has withstood the ravages of the *Phylloxera*. The Scupperong is the best-known cultural variety. The "Isabella" grape, a noted American variety, is one of the best of all the cultural forms of *Vitis labrusca*. Unfortunately the hardness of the wood and different structure of the bark renders this scathless species unfit for use as a stock for more tender varieties of other species. American Grapes have to Europeans a disagreeable musky or "foxy" flavour, and to improve the flavour and at the same time retain the vigorous constitution of the American Grapes, hybrids have been obtained between *V. labrusca* and European varieties of *V. vinifera*, as well as between *V. vinifera* and *V. cordifolia*; and it is interesting to note, in the case of these hybrid Vines (as in hybrid Rhododendrons), that the more the hybrid or half-breed assumes the aspect and characteristics of the tenderer parent, the less is it suitable for the northern climate—or, in other words, what is gained in flavour is lost in constitutional vigour.

According to Dr Regel, the cultivated Grape-Vine (*Vitis vinifera*) is not of pure specific descent, but is a hybrid between *V. labrusca* and *V. vulpina*, both of which are natives of North America, Japan and China, Manchouria, and the Himalayas. M. Regel derives his conclusions from the following facts: "1. The Grape-Vine is not known in a truly wild state, except as an escape from cultivation; 2. The species *labrusca* and *vulpina* are truly wild in that district of Asia where the culture of the Vine originated; 3. The European Vine, introduced into America, has never given such good results there as have the varieties of *V. labrusca* and *V. vulpina*."

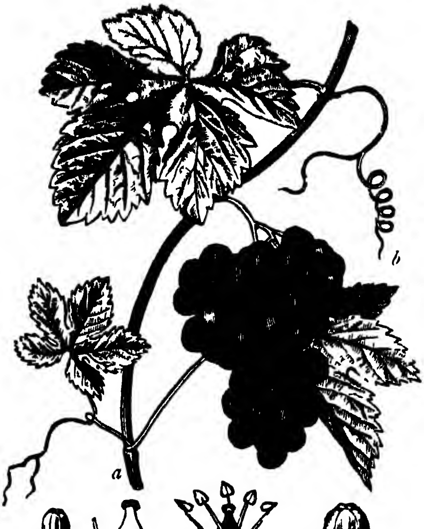
Vines raised from seed are nearly as variable as Apples, Plums, Pears, or other cultivated fruits, both black and white

varieties being produced from seed taken from the same cluster. In 1869 Mr A. F. Barron raised fertile flowers of Royal Muscadine (Chasselas de Fontainebleau) with pollen from the Black Monukka, a small-berried, thin-skinned variety, having very tender and quite seedless flesh. The object of this cross was to obtain a race of seedless varieties with large berries. From the seeds obtained ten or twelve varieties were raised—some black, others white, and some of both kinds having very small seedless berries, even smaller than the Black Monukka; but none of the varieties are of any value. M. Bouschet has improved some of the French-wine Grapes in colour of the juice and earliness by crossing such varieties as Aramon (Burchard's Prince), Carignane, and Grenache (Alicante de l'Hérault) with an early variety having very highly coloured juice, named Le Teinturier (see 'Jour. Hort. Soc.' (new series), i. 49; and at p. 135 are some interesting remarks by the late Mr J. Standish on raising seedling cross-bred Grapes).

Mr George Haskell of Ipswich, Massachusetts, has originated a race of Grapes by intercrossing the native American *Vitis riparia* with European varieties, and *vice versâ*. One or two varieties raised from *V. riparia* fertilised with pollen of Black Hamburg and White Chasselas are described by Dr Hogg (see 'Jour. of Hort.,' 1875, p. 420) as being very good, with a flavour quite distinct. The influence of the cross is very apparent, and we may hope to improve our Vines by infusing into them some blood from the hardier races. Dr Wylie has also produced some fine hybrids between the American and European varieties, and some valuable varieties have been raised by Mr Rogers.

Although numerous cultivators have raised seedling varieties of Grapes in this country, many of them being varieties of more than average merit, yet I believe I am right in saying that no attempt has as yet been made to obtain improved hardy or open-air varieties for wine-making. At Woodstock Mr Fenn and other cultivators grow good open-air Grapes, and make excellent wine; and we await the result of the Marquis of Bute's vineyard experiments with considerable interest; but whether it succeed or not, the fact remains, that small quantities of pure and wholesome wine are made every year from British open-air Grapes, and there is no reason why this quantity should not be largely increased, especially in the southern counties on warm dry soils suitable to the Vine. Two varieties —Esperione and the old "Black Cluster"—ripen their fruit on sunny walls in average seasons, as doubtless would also many of the French-wine Grapes; but if wine-culture is to be suc-

cessful in this country, we must follow the example set us by the American and Californian Grape-growers, who have a vigorous hardy race of Vines, the result of hybridizing *V. vulpina*, or Southern "Fox-grape," with the Northern Fox-grape (*V. labrusca*), and which are found far more productive and hardy in America than the European varieties grown in French, Italian, and Spanish vineyards. Some years ago (1867-68) several American kinds of Grapes, including *V. vulpina*, *V. labrusca*, and some



Vitis vinifera, L (*the common Grape-Vine*) *a*, *Fruiting branch, with b, the tendril, c, Flower-bud; d, Section of pistil, showing the 2 celled ovary with two upright ovules, e, Flower, showing the petals united at the apex and separating at the base, with the disc surrounding the base of the ovary, f, Stamens and stigma, with the small almost entire calyx, and the disc The corolla has fallen*

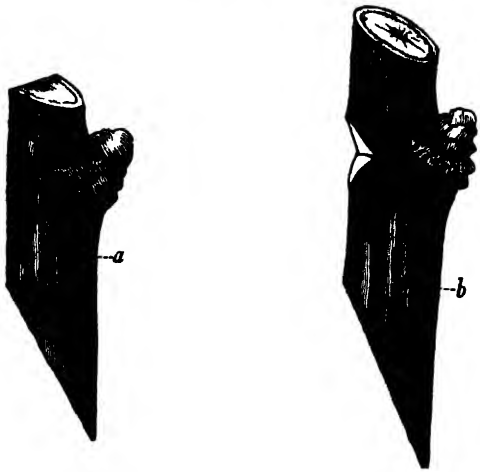
of their varieties, were grown in the Royal Horticultural Society's garden at Chiswick as ornamental climbers, and bore very heavy crops of fruit. The flavour of these Grapes being peculiarly strong and musky, they would not compare with Hamburgs and Muscats for dessert purposes; but as wine Grapes, along with Esperione and Black Cluster, they would be valuable for their hardy and prolific character. Any intelligent cultivator might obtain the North American species, and

by a series of judicious crosses with the two last-named varieties or Royal Muscadine (which also not unfrequently ripens its fruit on walls having a southern aspect), I feel confident a race of prolific varieties, sufficiently hardy to stand our climate, and valuable as affording Grapes for wine-making, would be obtained. Even as it is, one cannot see the numerous instances of the Vine ripening its fruit as it now does, without any cultural attention, on cottage and tenement walls at Knightsbridge, Brompton, South Kensington, and also in the more suburban parts of London, without wishing that some society or enlightened individual would take up the subject, and give it a thorough trial in a favourable locality. The Esperione, as we have before stated, almost invariably ripens its fruit in this country in the open air on walls; and it, together with other varieties, might possibly be much improved for open-air culture bv grafting them on the North American species or varieties as stocks. At any rate, here is another field of inquiry and research well worth the attention of our go-ahead horticulturists. In the Herault, fifteen millions of American Grape-Vines (principally the variety known as Clinton) have been planted in districts where the Phylloxera has done the most damage. The unanimous opinion of the growers, to whom success or failure in the Vine crop is of the greatest importance, is that the American Vines resist Phylloxera better than the French ones; and if in some cases the quantity and flavour of the fruit is not all that could be desired, they form strong and vigorous rooting stocks, on which the approved French Vine Grapes succeed better than on their own roots.

In the 'Gardeners' Chronicle,' 1871, p. 836, is a highly interesting and very suggestive article on the setting of Grapes, from which it appears that the irregular and enormous berries found in some bunches of Grapes are due to the enlargement and displacement of the seeds, these seeds being generally barren or sterile. It is a singular fact that all stoneless or seedless Grapes—such as Black Monukka, and the Corinth or "Currant" Grape of Zante—have very small berries; and we often see the same depauperation shown in seedless berries of Muscat, Hamburg, and other varieties, which have not been properly fertilised. Hence it seems useless to hope for a race of large-berried seedless Grapes; but if we could get at the secret hinted at above, and by some course of culture or management render the seeds of our Grapes larger, even at the cost of sterility (since fertility is not required in the seeds of fruit to be eaten), we might obtain a race of enormous-berried

Grapes, which just now, when large berries are admired, would be a decided acquisition.

Vines on their own roots or for stocks in this country are generally propagated from "eyes" or cuttings of the last year's wood, taken off when the Vines are pruned—say, in December or January. Select medium-sized and thoroughly hard or well-ripened wood; for there is a certain analogy between a bud or eye and a seed or a bulb and perfect ripeness, for the full development of their several parts is necessary to insure their vigorous germination or growth. Cut the eyes as represented in our engravings—fig. *a* being the eye ready for pot-culture,

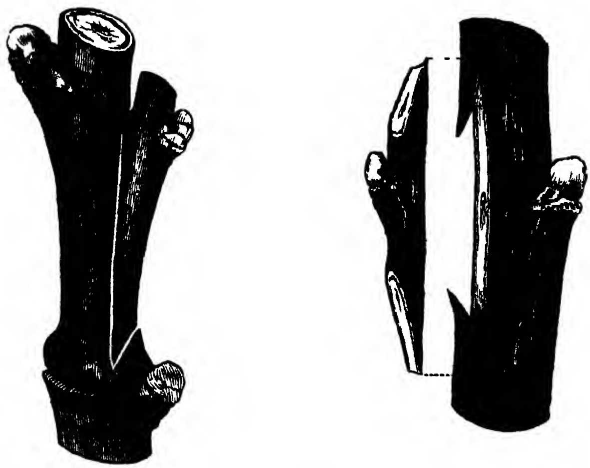


Inserting Vine eyes

and fig. *b* the manner generally adopted when they are intended for planting in the border for permanent Vines. After the eyes are prepared as at fig. *a*, plant them in clean, well-drained, four-inch pots, firmly filled with fresh turfy loam and sand: rich or manured soil should be avoided, as it becomes sour or stagnant before root-action begins. Dibble the cutting or eye into the centre of the pot with a little silver sand around it, after which water well, and set the pots in a cool house or pit for a week or two, to allow the eyes to "callus" ere they are placed in heat. Cuttings (fig. *b*) for border planting may be buried in a shallow layer of soil or in boxes, and placed in a cool pit or vinery, where they will "callus;"

and they can be planted in May, or even earlier, where they are wanted.

Grafting.—This is a ready way of renovating old Vines; and the safest plan to effect this is to bring in young canes in pots, and inarch them on the old established canes after the latter have made twelve to fifteen inches of young growth. The stocks should always be in a much more advanced state of vegetation than the scions, to prevent bleeding. Eyes with a portion of the old wood may be inserted in old canes, as shown in our diagram. "This should be done without cutting too deeply into the stock, which would cause it to bleed, and so prevent a union; but a very shallow cut one and a half inch long should



Vine-grafting

be made, with a cross downward cut at the end, and the graft be fitted to it as shown in our sketches. The graft should be bound up with bass matting rather tightly, and then the junction covered with grafting-wax." Whip, veneer, or even budding succeed well if neatly and quickly performed; and for indoor culture the Hamburg or Muscat of Alexandria stocks are best, as a general rule.

From the 'Florist' we learn that "Mr J. Douglas has with facility grafted *Vines* by simple whip-and-tongue grafting *young wood on young wood.* A moderately vigorous young shoot, with the wood firm, was chosen, and a scion to correspond, and four

out of five grafts thus put on grew away freely. They were only bound with matting, and probably clay or grafting-wax would better secure the union. The advantages of this plan will be patent to all."

The influence of the Vine stock over the scion is amply illustrated in the following quotations; and a well-conducted and carefully-recorded series of experiments with Vine stocks would be of great value from a horticultural point of view. A correspondent of the 'Florist' writes: "I have growing here a West's St Peter's, grafted on a Purple Constantia, and I find the fruit greatly improved in flavour, while the berry is much larger, and quite a fortnight earlier. The two adjoining Vines are West's St Peters, and very healthy, one on its own roots, the other grafted on the Black Prince; in these two cases there is no perceptible difference. In another house I have a Black Hamburg inarched on the Purple Constantia, using the two stocks for the one Vine, and in this case the Hamburg is quite a fortnight earlier, and the fruit much richer in flavour. The Vines on the Constantia appear to have the lead in vigour of all the other Vines. In the same house is a Muscat of Alexandria inarched on the Royal Muscadine, using the two stocks for the Muscat Vine. On this Vine the fruit sets almost to a berry, and is very vigorous. These Vines are freest, which is a consideration greatly in its favour."

Mr David Thomson contributes the following valuable information: "We have the Gros Guillaume Grape—so long miscalled Barbarossa—in two different houses, grafted on the Muscat of Alexandria, and in another and cooler house on Black Hamburg roots. In the Muscat house, and in the cooler Hamburg house, we have it also on its own roots. The results under these three conditions are strikingly different. In both houses on the Muscat stock it swells its berries much more regularly, and to a larger size, than it does on its own roots in the same house, and on Vines of the same age. In the cooler Black Hamburg house it neither makes such large berries nor bunches; but it colours much more rapidly than in Muscat temperature on the Muscat stocks, or than it colours on its own roots in either house. We have one vigorous Vine on its own roots, in which there are just two moderate-sized bunches; but these two bunches are not nearly so fine in berry as bunches four times their size on Muscat roots under heavy crops. We consider this one of the noblest-looking, and in every respect one of the best, late Grapes in cultivation; and to those who wish to grow it to the greatest per-

fection in bunch and berry, as well as high finish, we would say, graft it on a Muscat in a Muscat temperature, and allow the stock at the same time to develop either one or two bearing-canes, as well as the graft of Gros Guillaume. It must be added that it fruits more freely under closer pruning on the Muscat than on its own roots, or on the Black Hamburg."

Mr J. Smith, of Waterdale, says: "Most of our shy-growing Grapes may be improved, and even shanking to some extent prevented, by grafting. Mrs Pince has more compact bunches, and finishes better; and Muscat Hamburg and Madresfield Court grown in this way are not liable to crack. The Barbarossa, grafted on the Black Hamburg, fruits freely on spurs, and produces more compact bunches, which are more satisfactory for hanging late than large loose ones."

Inarching Bunches of Grapes.—Mr Temple says: "This practice is by no means new; but from experiments which I have made, I am inclined to believe that there is little advantage to be gained by grafting a number of bunches together. To see what size a bunch can be made to attain was not, however, my object, but to ascertain what influence one kind of Grape would have on another. A bunch of Foster's Seedling spliced to one of Lady Downes seemed to be flaccid and tasteless compared with the same kind left alone. A bunch of Muscat of Alexandria grafted on a Trebbiano seemed to have little or no Muscat flavour in it. A Lady Downes "worked" on a bunch of itself, was unchanged in flavour and appearance. In order to have handsome bunches as well as increased dimensions by grafting, it is necessary to use small ties for training one of the bunches neatly over its companion, so as to maintain a symmetrical form. Grafting must be done either before the bunch comes into flower or very shortly after the berries are set; but careful and steady hands must perform the operation."

It is always desirable that cultivators, when recording experiments in Vine or other grafting, should state fully whether the scion receives all the nourishment afforded by the stock, or whether it is merely inarched or budded on the stock as a branch. This is a most important point; for it is patent that if the stock is entirely devoted to the scion, its individuality and constitutional characteristics must be overruled to a greater or less extent, just as the scion is strong or weakly in habit; but if the stock is allowed to bear foliage of its own, as well as that of the scion, its influence must necessarily be much greater.

Seedling or Cross-bred Grapes.

Of course nearly all the Grapes in cultivation are either seminal or cross-bred variations, but those named in the following list are interesting as having been raised from well-known varieties in English gardens, and I give them here as examples of what intelligent cross-breeding or even seminal variation and selection will effect in a few years. Of late years the greatest gain in the way of new Grapes has been the late-keeping varieties.

Abram Bass.—A seedling raised by Mr Pearson of Chilwell, from Mrs Pince's Black Muscat.

Bidwell's Seedling.—A black seedling Grape raised by Mr J. C. Bidwell of Exeter, and sent out by Messrs J. Veitch & Sons, who first exhibited it in 1858.

Ascot Citronelle.—Bunch 10-12 inches long, slightly shouldered, the berries being white with a thin bloom, and the point of the style persistent at the apex. It was raised by Mr Standish between Blanc de Saumer and Muscat Citronelle, and has a Muscat flavour.

Chilwell Alicante.—An oblong-berried black variety, raised by Mr J. Pearson at Chilwell. It is a seedling from Black Alicante, and first fruited in 1871.

Dr Hogg.—A yellow round-berried variety, raised by Mr J. Pearson. It is a seedling from Duchess of Buccleuch, which it resembles in flavour, but is much larger in berry (1872). In reference to this now well-known and excellent Grape, the raiser says: "I tried what the effect of crossing Ferdinand with other Grapes would give, and raised a large batch of seedlings, some also from other crosses, which were all planted together. Some of these were exhibited 6th September 1871. From them the committee of the Royal Horticultural Society selected one for a first-class certificate, and as the chairman, Dr Hogg, appeared much struck with it, I named it after him. I knew it was a seedling from the Duchess of Buccleuch, and never could make up my mind what was its other parent, or if it had been crossed at all. Knowing that all the race of Grapes, comprising Muscat Muscadine, Chasselas Musqué, Joslin's St Alban's, which were the result of a cross between the Muscat of Alexandra and Royal Muscadine, to which the Duchess of Buccleuch belongs, were, though very high flavoured, dreadfully subject to crack, I feared the same might be the case with mine, and so never recommended it to any one."

Duchess of Buccleuch.—Bunch long and tapering; berries

small, round, greenish white, having a rich Muscat or "Chasselas Musqué" flavour. Raised at Dalkeith by Mr W. Thomson.

Duke of Buccleuch.—Bunch 8-10 inches in length; berries very large, with a prominent style covered with a rich amber skin, and having a juicy "Hamburg" flavour.

Early Ascot Frontignan.—A hardy Grape resembling "White Frontignan" in appearance and flavour. It is one of Mr Standish's seedlings, raised from "Muscat de Saumer," fertilised with pollen from "Chasselas Musqué."

Emperor of Morocco.—An oblong black Grape, raised by Mr Pearson. It is a seedling from Black Morocco.

Ferdinand de Lesseps.—This is a distinct-flavoured Grape, the berries and bunches resembling Chasselas Musqué. It was raised by Mr Pearson, and is the result of a cross between the American "Strawberry" Grape and Royal Muscadine, the former being the seed-bearing parent. About 100 seedlings were raised, all worthless except this one, which is the most distinct of all Grapes in flavour, tasting like new honey or Strawberries and Pine-apple combined. The raiser thus alludes to it: "Here was at least a great curiosity, a pretty scented fruit, which few with their eyes shut would take to be a Grape. But every one does not like barley-sugar or new honey either, and then unfortunately the berries were little larger than those of the Frontignan, and the bunches scarcely so long, and though "Ferdinand" found many admirers, I never recommended any one to plant it who had not seen and tasted it."

Golden Champion.—A remarkably handsome, large-berried, golden Grape, raised by Mr W. Thomson at Dalkeith in 1863. (See 'Florist,' 1868, p. 217, for coloured plate and description.)

Golden Queen.—This is a very handsome variety, the result of a cross effected between Ferdinand de Lesseps and Black Alicante. It fruited for the first time last year (1873). The bunch and berry are in shape exactly like Madresfield Court, but the colour is a bright gold. The flavour is that of a Muscat of Alexandria, without any of the aroma peculiar to the Muscats, being in fact a rich, fleshy, sweet Grape. The foliage shows its hybrid origin, being strong, dark-looking, and feeling to the touch more like that of a Fig than a Vine. The wood is bright cinnamon in colour, and, taking fruit and Vine together, it is perhaps the most beautiful Vine ever seen growing.

Ingram's Hardy Prolific Muscat.—This is a seedling raised by Mr Ingram, and it fruited in 1861.

Lady Downe's Seedling.—This is well known as one of the

best of all late-keeping Grapes, and was raised by the Viscountess Downe, Baldersby Park, near Thirsk.

Madresfield Court.—This is a really first-class black Grape. It was raised in 1864 by Mr Cox, gardener to the Earl of Beauchamp at Madresfield Court, Great Malvern, and was selected as the best of a batch of seedlings obtained from the Muscat of Alexandria and the Black Alicante intercrossed in both directions. It proves to be a Grape of excellent quality, setting its fruit as freely as the Black Hamburg, than which it takes about a fortnight longer to ripen. It is figured and described in the 'Florist,' 1870, p. 265, and was sent out by Messrs J. and C. Lee.

Melville's Perfumed Muscat.—This seedling variety was raised by Mr Melville, Dalmeny Park. It is said to be a good deal like the White Muscat of Alexandria, both in bunch and berry, but more golden in colour when fully ripe, and sharper, richer, and more perfumed in flavour; very thin-skinned, tender-fleshed, and dissolving in the mouth. Its most striking peculiarity is the delicate agreeable perfume which it possesses. It is said to have sprung from Snow's Muscat Hamburg, *alias* Black Muscat of Alexandria.

Muscat Champion.—Bunches like large-berried Hamburgs, the berries having a reddish-black skin, generally much hammered. It has a Frontignan flavour, raised by Mr W. Melville, gardener to the Earl of Rosebery, Dalmeny Park, near Edinburgh, who fertilised flowers of the Mill Hill Hamburg with pollen taken from the Canon Hall Muscat.

Mrs Pearson.—This is another of Mr Pearson's seedlings, and is of the same parentage as "Golden Queen"—viz., Black Alicante crossed with Ferdinand de Lesseps.

Mrs Pince's Black Muscat.—This is a late seedling Grape of excellent flavour, but it rarely colours well. It originated from seeds sown by the late Mrs Pince of Exeter, and is valuable for its exquisite flavour and good keeping qualities.

Royal Vineyard.—This is a robust white or yellow Grape, bearing large bunches and oblong berries. It is said to be a seedling from the old "Syrian."

Venn's Black Muscat (Sneyd Seedling).—A very handsome black variety, raised by Mr Sweeting, gardener to T. G. Venn, Esq., Sneyd Park, Bristol. Its parentage seems to be unknown; it appears, however, to be only a good variety of the Muscat Hamburg.

Waltham Cross.—A very handsome white Grape, with oblong berries, sent out by Mr W. Paul in 1872.

White Lady Downe's.—A seedling from "Lady Downe's

Seedling, not crossed with pollen from any other variety, and similar in nearly every respect except colour to the seed-parent. It is one of Mr W. Thomson's seedlings raised at Dalkeith.

Royal Ascot.—Similar in appearance and flavour to the Black Frontignan. It was raised by Mr Standish from Bowood Muscat, crossed with pollen from Trouveren, and is curious as an instance of seminal ancestral reversion, it being a black offspring from white parents.

In addition to the above, numerous other varieties have originated from seed in this country; for example, we have quite a race of seedlings from the Muscat of Alexandria, of which Bowood, Tynningham, and Canon Hall may be named as examples.

Mr W. Thomson of the Vineyard, Clovenfords, who is well known as one of the most successful raisers of valuable new Grapes, has given me the following complete history of the four varieties he has already distributed. Two of them—namely, Golden Champion and Duke of Buccleuch—are the largest-berried Grapes in cultivation. White Lady Downe's keeps better than any other White Grape; and the Duchess of Buccleuch, although perhaps not so large in berry as is desirable, deserves a place in every vinery for its two excellent qualities—viz., fertility and excellent flavour.

"It was always a subject of regret with me," says Mr Thomson, "that the exquisite Chasselas Musqué Grape persisted in cracking just as it became ripe, and I accordingly set about raising a batch of seedlings, which I hoped would retain its fine flavour, fruit in a moderate temperature such as it fruits in itself, and be free from its defects. I began by using the pollen of the Muscat to impregnate the Chasselas Musqué, and also used its pollen to impregnate the Muscat. Every seedling I raised, of which the Chasselas was the female parent, was distinct in shape or size of berry from it, and none were so large. Amongst this batch, the only one I kept was the Duchess of Buccleuch; all the others had such radical defects that I at once discarded them. The Duchess has what is an unpardonable fault in these days of monster bunches and berries—it has a small berry; yet few will dispute its being very prolific, and it is of exquisite flavour.

"Of the seedlings of whom the Chasselas was the female parent, not one differed in any respect from it as far as its defects are concerned. Some were smaller, and some might be a shade larger, but all cracked and were discarded.

"I after this made an attempt in another direction, crossing

The following may be taken as a fair collection of seeds to crop an acre, making allowance for failures : Peas, 2 qts. ; Beans, 3 qts. ; Kidney Beans, 3 qts. ; Scarlet-Runners, 1 qt. ; White Cabbage, 4 oz. ; Red do., ½ oz. ; Savoys, 2 oz. ; Brussels Sprouts, 1 oz. ; Borecole or Scotch Kale, 1 oz. ; Cauliflower, 2 oz. ; Brocoli, 6 oz. ; Carrots, 6 oz. ; Parsnips, 4 oz. ; Turnips, 4 oz. ; Red Beet, 3 oz. ; Scorzonera, 2 oz. ; Salsify, 2 oz. ; Radishes, 3 qts. ; Flanders Spinach, 1 qt. ; Round-leaved do., 1 qt. ; Onions, 6 oz. ; Leeks, 2 oz. ; Cardoons, ½ oz. ; Celery, 1 oz. ; Lettuce, 4 oz. ; Endive, 2 oz. ; Parsley, 2 oz.

TABLE SHOWING THE PROPER DISTANCES FOR PLANTING VARIOUS FRUIT-TREES.

Standard Pears on Pear stocks, for orchards—25 feet apart.
Pyramidal Pears on Pear stocks, not root-pruned—20 feet apart.
Do. do., root-pruned—10 feet apart.
Do. do., on Quince stocks, not root-pruned—6 feet apart.
Do. do., on Quince stocks, periodically lifted—4 feet apart.
Bush Pears on Pear stocks, periodically lifted or root-pruned—6 feet apart.
Do. do. on Quince stocks, periodically lifted—4 feet apart.
Pears on Pear stocks, trained horizontally on walls or espaliers—18 feet apart ; the same to be root-pruned as occasion may require.
Pears trained in vertical, oblique, or horizontal cordon fashion, may be planted, if upon walls, 18 inches apart, or more or less as the taste of the planter may dictate.
Pears trained in horizontal cordon, to form edgings to walks, or quarters of the garden, should be planted on stems 1 foot high, and trained along galvanised wire, strained and supported on iron pins, a single shoot only being made use of.
Pears trained fan-shape and root-pruned—15 feet apart. The above distances will also do for Apples, Cherries, and Plums ; these last, when trained as pyramids, require to be grown with stems 18 inches to 2 feet high, as if cut shorter, they will throw out so many strong branches just above the junction of the graft and stock, that it will be found, with the greater number of sorts, so much cutting will require to be done that the trees will gum and die, and present great difficulty to form them into nice pyramids.
Peaches, Nectarines, Apricots, Plums, and Cherries, when planted against walls, are generally and best trained fan-shape, and should be from 12 to 15 feet apart, and kept periodically lifted and replanted on the surface, merely covering the roots with a few inches of the soil.
Bush trees of Pears on Quince, Apples on the Paradise, Cherries on the Mahaleb, and Plums may be planted about the same distance apart as Gooseberries and Currants—*i.e.*, 5 feet apart in the rows, and 5 feet from row to row. They should be lifted biennially, or as often as required, in November, and they will then form a charming fruit-garden.

APPENDIX.

KŒLREUTER was probably the first amongst us to raise hybrid plants, his experiments in that direction having taken place early in the eighteenth century; and Linnæus gave an impetus to the study of vegetable sexuality by the publication of his views on the subject in his 'Fundamenta Botanica.' Gaertner and Wichura also threw much light on the question of hybridity by their experiments made on the Continent; and in this country the late Dean Herbert stimulated horticulturists by the production of numerous beautiful hybrids, and also by the publication of his celebrated paper on 'Hybridisation among Vegetables' in the 'Journal' of the Royal Horticultural Society, vol. ii. (1847), pp. 1-81. Artificial hybridisation and cross-breeding had now, in fact, become general. About this time Fuchsias and Calceolarias became greatly improved, as were also Gladioli, Rhododendrons, and Camellias; nor were ornamental plants alone the subjects of ennoblement, inasmuch as Knight had previously directed his attention to the amelioration of Apples, Pears, Plums, Peaches, Cherries, and Peas, and with great success, some of his seedlings being still popular in our gardens, notably Knight's Monarch Pear and his Marrow Peas. Among the earlier and most successful hybridisers in this country after Dean Herbert may be named Mr James Cunningham, Messrs Colville, Mr Anderson-Henry, Mr Gowen, Mr J. Standish, and Messrs Rollisson, to the last of whom we are indebted for forty or fifty varieties of the most beautiful seedling or rather hybrid Heaths. About 1854, Mr J. Dominy raised the first hybrid Orchid (*Calanthe Dominiana*). This has been succeeded by about fifty hybrids belonging to other genera, and it is not too much to say that the production of these hybrids has completely revolutionised the somewhat restricted views formerly held by botanists as to the generic and specific distinctions of Orchidaceous plants. At the present date hybridisation and cross-breeding are everywhere largely practised, not only in European gardens, but also in those of Japan and China, where, indeed, the arts of culture and plant improvement by selection and grafting have been carried on from time immemorial. Their improved races of Primulas, Azaleas, Lilies, Diospyros, Pinks, Irids, Chrysanthemums, and Moutan Peonies, are indeed as wonderful in their way as anything produced by hybridisers in this country. New forms among plants, the result of hybridisation, may be said to constitute one of the most remunerative branches of the nurseryman's business; but apart from all considerations of profit, cross-breeding deserves the most careful attention. Mr Darwin's new book on 'Cross-fertilisation'* is just to hand as this sheet

* Murray, London: 1876.

goes to press, and in it the benefit of cross-fertilisation is fairly proved so far as cultivated plants are concerned. "Self-fertilisation assures the production of a large supply of seeds; cross-fertilisation, however, not only does this in a more thorough manner, but the plants from cross-fertilised seeds are much more vigorous, and their seedlings more fertile and more variable, than self-fertilised seedlings. The greatest good follows cross-fertilisation when one of the parents has been grown under different conditions, by which its characters have been altered or differentiated, or if one has varied spontaneously (or 'sported'), the results are generally good. If injury ever does follow self-fertilisation, it is owing to the want of variation or mutual attraction in the sexual elements." If fixity or permanence is requisite in any particular variety, the best way to obtain this is to carefully self-fertilise the plant so as to keep its distinctive characters pure; and if this is done for six or seven generations, the result is that seeds from plants so treated reproduce the form with tolerable exactness. Cultivators have long known the advantages of change of seed, and Mr Gower* had pointed out the advantages of cross-fertilisation with a different individual from a fresh stock in 1869; but Mr Darwin's last contribution to science is of immense importance, as proving this in a more satisfactory manner. We have now abundant evidence that a larger productiveness in the way of flowers, fruits, and fertile seeds follows judicious cross-fertilisation than where no interference in that way has been instituted; indeed, most striking evidence of the beneficial results obtainable by the blending or cross-breeding of races is afforded by the Old Briton, Roman, Saxon, and Norman races now amalgamated under the name of Englishmen. Hybrid and cross-bred seedlings often show evidence of greater fertility and a more vigorous habit of growth than either parent, although this vigour is sometimes obtained at the expense of complete or partial sterility. It was formerly thought that all hybrid plants were infertile; but we now find that very few hybrids of the first generation are completely sterile—M. Naudin thinks not more than 25 per cent; while the cross-bred or cultivated varieties of hybrids, as well as those of wild species, are not unfrequently more fertile than either the parent species or the primitive type. Hybrids of hermaphrodite plants may be incapable of bearing fertile seeds under any circumstances, and yet their pollen may be capable of fecundating the ovules of another species or hybrid, as in the case of Nymphæa, Narcissus, and Passiflora; while on the other hand, some hybrids (as well as wild species) have impotent pollen, but are readily rendered fertile by the application of pollen from an allied species or variety. As it is possible for either the male or female organs of a hermaphrodite plant to become impotent through the disturbing influence of high culture, hybridism, or cross-fertilisation, so also is it not uncommon for monœcious plants—Begonias, for example—to become hermaphrodite; and diœcious plants, as Cœlebogyne, Aucuba, and Skimmia, sometimes bear anthers among the female organs of flowers on the female plants; while, as has been shown by Spruce and others, it is not unusual for diœcious Palms and other plants suddenly to produce male instead of female flowers, or *vice versâ*. Mr Meehan and other observers have pointed out that nutrition influences the production or strength of the sexual organs more than is generally supposed, and of this we get some evidence in the case of trees grafted on restricting stocks, which are thus rendered more fruitful; and we know that a course of semi-starvation leads to fruitfulness as a rule, just as over-feeding leads to vegetative growth and leafy exuberance; and even the alternate production of male and female flowers on diœcious plants may be due to external conditions.

* Williams's Choice Stove and Greenhouse Flowering-Plants, p. 31.

Apart from the true or confirmed monœcious plants, there are large numbers of hermaphrodite species known to exist, which are to all intents and purposes practically monœcious, for either the pollen is shed before the stigma is receptive (as in Agave, Lobeliads, Composites, &c.), or the stigma develops itself and becomes fertilised by the pollen of older flowers (as in Calceolaria) before its attendant anthers are fully developed or part with their pollen. Again, many Orchids, Yuccas, and Asclepiads, are nearly entirely dependent on insect agency for their perfect fertilisation, and thus they are peculiarly liable to cross-fertilisation or even natural hybridism. The greater or less sexual affinity or consanguinity of species, is proved by the more or less perfect manner in which hybridism can be made to take place between them, as shown by the relative quantity and quality of fertile seeds produced; but of this relationship we have no external evidence before hybridisation has been effected, since species which closely resemble each other in every way cannot be made to unite, while the reverse is frequently the result where great disparity in size, habit, or colour would lead one to think otherwise. Again, two species (or even two forms of a species) in a genus (A and B) may refuse to hybridise—*i.e.*, they will not interbreed; but by crossing one of these (say B) with a third species (C), the hybrids thus obtained will not unfrequently breed with A, as has been proved in the case of some kinds of Nicotiana and Dianthus. This fact of some species refusing to interbreed or unite sexually, except by the intervention of a third species, becomes all the more singular and interesting when we remember the partial analogy which exists when grafting is substituted for hybridising. Thus it is a well-known fact that some varieties of Pear will not unite readily with the Quince or Hawthorn stocks, and this difficulty is surmounted by the use of "intermediate" stocks. Thus the Quince is grafted with the scion of a Pear which is known to unite readily and succeed well on it as a stock, and on this is worked the variety of Pear which refuses to unite well with the Quince.

M. Karl Koch, in a recent lecture on fruit-trees, says he has heard in the East that some of our races of dessert Pears have descended from a hybrid or hybrids obtained between the Pear and the Quince—both of which fruits are much more variable than is generally supposed—from the latter of which they have obtained flavour and aroma. Some kind of Pears now grown closely resemble the Quince in shape, colour, and peculiarly long calyx-lobes, as well as in aroma and flavour; and that such hybridity is not improbable may to a certain extent be assumed, seeing that some races of Pear show a marked preference for the Quince stock, while others succeed only on the free stock or Pear. When writing the suggestions on hybridising the Quince (see p. 471), I held the idea that hybridity had occurred between that fruit and the Pear; and I have no doubt but that the possibility of this may be proved by any one who will undertake to make experiments in crossing some of the European or Asiatic forms of the Quince and Pear.

Another fact of some importance connected with hybridisation is, that part of the ovules in the same pod or capsule may become fecundated by the pollen of one species, and part by another; and when two species or varieties are cross-fertilised, the elective affinity—the competitive strength or fixity of character possessed by each parent—varies considerably, although, as a general rule, the influence of the male or pollen parent is prepotent; nevertheless, that this is not always the case is proved by Mr Parkman's and other hybridisers' experience with Lilies, and by the invariable prepotence of Gesnera zebrina and Nepenthes Rafflesiana when cross-fertilised reciprocally with other species of their respective genera. 'We find

evidence that this question of [illegible] the male and female parents varies, so far as [illegible] from the almost, if not entire, overruling [illegible] entire female prepotence, as in the case of [illegible] that this range of variation in hybrid plants is due to [illegible] characteristics or fixity of habit in the parent species seems [illegible] conclusive, if it be not actually proved by the fact that in some few cases—notably in that of some Willows as observed by Wichura, and of Mr Seden's Lady's Slipper—the characteristic force of the two parents is so equally balanced that the offspring of both, when crossed reciprocally, appear to be precisely alike. In this respect, also, we have observed analogous results in the case of grafted plants, and this, taken with the facts which have been observed in the grafting of Potatoes and Cytisus, seems to indicate that the same general law governs the union of gemmules, whether the union be sexual, as in the case of hybridism and cross-breeding, or vegetative, as in the case of grafting and budding. If the same law apply to the union of the gemmules of the vegetative and sexual organs—and from the facts at present known to us we may reasonably infer that this is the case—then grafting under certain conditions may facilitate hybridism, and *vice versâ*, by drawing the characteristics of like plants into a still nearer relationship than had before existed. As hybridism is more likely to be successful when all the flowers are removed off the seed-bearing parent, except those fertilised by foreign pollen, so in grafting we find that detached scions take more readily on a young headed back stock—especially if the relationship be not of the closest kind—than when worked on a branch or stock which is itself allowed to grow and bear flowers and fruit; and even when the scion takes well under both sets of conditions, the practical results are often very different. The late Mr Pearson, of Chilwell, after having experimented with Grape Vines grafted on different stocks, came to the conclusion that the stock, if completely headed off, and not allowed to make any leaf-growth of its own, lost all influence on the scion in about four years. It has now become highly essential to know not only whether varieties of fruits are grafted and the name of the stock used when they are described as being successful or otherwise in different soils or localities, but it should also be explicitly stated whether the stock or intermediate stock, in the case of double-grafted trees, is itself allowed to grow and bear fruit, or whether its duty is merely to support the scion grafted on it. That scions do sometimes influence the stocks on which they are worked is evident, as has been already shown; the converse of this, or effect of the stock on the scion in many instances, has long been known, but there are cases in which there is no apparent evidence of either stock or scion exerting any reciprocal influence, each preserving its own character intact, although they may be dividing the functions of plant-life between them. Variegation can in many cases be communicated to a green-leaved plant by budding or grafting it with variegated scions from the same or allied species. In the case of Abutilons this is a well-known fact, and soon after Messrs Veitch introduced the vermilion-flowered, green-leaved *A. Darwini*, a variegated form was artificially produced on the Continent by budding it with scions from the golden-blotched *A. Thompsoni*. This practice has also succeeded with the Ash, Sweet Chestnut, Laburnum, Pelargonium, Common Chestnut, Maple, Jasmine, Oleander, and Passion-flower. Black, white, and red or striped Grapes have been produced on the same bunch by splicing the branches of a black-berried and a white-berried Vine together; and analogous effects have been produced by grafting the tubers, or even the haulm only, of red and white Potatoes. The oft-quoted *Cytisus Adami* is said to have been produced by inserting a

shield bud of *C. purpureus* beneath the bark of *C. laburnum*, and we have many records of Pears being altered in size, colour, flavour, and time of ripening, owing to their having been grafted on the Quince stock. Hence it will be seen that grafting is not to be relied on as a certain means of reproducing either varieties or species in a pure state, but, on the contrary, may in some cases be employed to change the colour or other attributes of a species or variety in a manner closely analogous to, if not identical with, hybridism and cross-fertilisation.

Mr Maule has succeeded in grafting pieces of a Potato on the common Bitter-sweet (*Solanum Dulcamara*) as a stock, and was surprised to find that the roots of the stock developed little tubers; and a similar result is said to have since been obtained by grafting the Jerusalem Artichoke (*Helianthus tuberosus*) on the common Sunflower (*H. annuus*) as a stock, tubers having been developed on the roots of the Sunflower. Further and carefully-conducted proof experiments in these particular instances are desirable; nevertheless, the coincidence of those two cases of tuber-development, induced by grafting tuberous species on non-tuberous rooted ones as stocks, is a strikingly suggestive one to gardener and botanist alike, especially when viewed in the light which is now being diffused by the seemingly spontaneous variations of grafted and budded Roses, Laburnums, Pears, Apples, Plums, and Grape-Vines.

We have so many curious hybrids and variations produced by grafting and by budding, that what is now especially desirable is a series of proof experiments with the parents of these well-known hybrids, reputed graft variations, &c., so as to verify the voluminous observations of cultivators and others, bring out facts, and thus obtain reliable data, or light, by which we may peer still further into the hazy atmosphere of vegetable physiology. The field for carefully-organised experiments of the kind here indicated is too wide for any single-handed investigator; indeed it is work which rightly belongs to a botanical garden.

There is one point to which I particularly wish to allude in reference to graft-hybridity—namely, the possibility of inducing variegation by mere sap-inoculation, or transfusion of coloured cellular tissue from a variegated plant to a green-leaved one. Blair and Fairchild speak of this; indeed the fact was observed in a Holly by the first-named author a century and a half ago (see p. 62), and often since, especially in the case of green-leaved Abutilons and Jasmines, which have been budded and which have at once assumed variegated foliage, although the variegated bud inserted died away gradually, that is, refused to "take" or unite with the stock. In the case of variegated Pelargoniums, engrafting a very little cellular tissue from a coloured part of the stem or leaf is amply sufficient to induce variegation in a green-leaved plant: and this subject deserves the attention of cultivators and hybridisers; since now we can readily induce leaf and stem variegation, it is not only possible, but highly probable, that variegation or variation of colour in the flowers, fruits, and resulting seedlings will follow. Another point of great importance to hybridisers and propagators is a knowledge of the extremely variable characteristics possessed by different individuals, not only of the same species, but even of the same variety. This strong individuality of plants has been pointed out by Darwin in the case of Pelargoniums, by Meehan in certain Lilies, by the late Mr Pearson in certain forms of the Moor Park Apricot; and it is an everyday observation made by all intelligent Orchid-growers and general plants-men.

In the case of the Wellingtonia, for example, Messrs C. Lee & Son find that the branches of some individual trees root freely as cuttings, while those taken from other individuals, growing apparently under precisely

similar conditions, as invariably fail to grow. The lesson to be learned from these observations by the propagator in his grafting and hybridising operations is, that a wide view of a species or variety must be taken, and if any two individuals fail, after having been operated on reciprocally, others must be selected, and every little variation in light, heat, air, and nutrition must be studied, and then we shall hear of fewer failures than is now the case.

Much has been written by Darwin and others on the non-permanence of varieties; but the supposed disappearance of these is often reappearance under a new name, as shown in the following extract from the 'Gardeners' Chronicle' (1876, p. 396):—

"The disappearance of varieties is no proof whatever that they have died out. Varieties are being superseded almost daily, but supercession is no proof of decrepitude or weakness. Novelty alone, and the increasing love of it, is constantly treading down older varieties. Improvement is at work in the same direction; every accession of new vigour threatens to extinguish older and less powerful varieties by asserting and perpetuating the supremacy of the strongest. The survival of the fittest means, when left to the operation of natural laws, the suppression and extinction of the weakest. Those and other influences are always at work to cause varieties to disappear, and that independently of any inherent tendency in themselves to die out.

"It is impossible to estimate the potency of altered conditions, abnormal developments of particular parts for special purposes, high or unnatural means of cultivation, exhausted soils, and consequent semi-starvation; tendencies to revert backwards, and others equally powerful, perhaps, to run forward, and break or sport into new forms, colours, sizes. These and other influences all lead to change of varieties, wholly independent of their dying out. As we try to measure their potency, and enter into their ceaseless activity and mysterious modes of bringing about changes, the marvel is, not that so many varieties have disappeared, but that so many remain constant. Vital force is somewhat like a spirited horse: it is closely and thoroughly harnessed by certain laws to reproduce its like, but every now and again it kicks over the traces, and leaves as the footprints of its erratic outbreaks a new variety. It may be better or more serviceable, assuredly it is newer than the old. In this last, combined with the love of novelty in men, amounting pretty well to a passion, we have a security for the careful conservation of the novelty, and it may be in consequence a contemporaneous neglect of the older variety. Therefore the disappearance of old sorts is no proof whatever that they have died out, while, on the other hand, their continuance is a sure and certain proof of their stability.

"Dr Asa Gray endeavours to establish a distinction between the durability of varieties increased by seed and those propagated by buds or offsets, and considers that the former are likely to be more permanent than the latter, inasmuch as cross-breeding, as illustrated by Darwinism, was appointed not merely to perpetuate and increase the numbers of plants, but also to reprime them with steadying force to prove the constancy of varieties. It is based upon the fact, so clearly illustrated by Mr Darwin, that cross-fertilisation is Nature's rule of propagating varieties; and the inference—for the argument here is nothing more—is, that consequently it is the mode that assures most stability, else Nature would not have provided so much and so many admirable adaptations to insure this particular mode of increase. This, however, is begging most of the question; we know next to nothing of the why and wherefore of any of Nature's proceedings; even Mr Darwin, the most careful observer and lucid

describer of facts, lands us in mist when he leaves the field of observation for that of explanation or imagination. Apart from the question involved, there are obvious reasons why propagation by seed would be Nature's usual mode of increase; and, according to the present order of things, and the correlation of insect and plant life, cross-fertilisation is a necessity—it cannot be prevented but by a miracle. But, instead of being an element or the foundation of the stability of varieties, it is rather the very vortex of change, unless, indeed, it could be proved—which it cannot—that only the same varieties can be cross-fertilised by each other. On the contrary, it is obvious that all the varieties of a species can, as a rule, be freely cross-fertilised; and, popularly understood, cross-fertilisation means the latter, not the former—and is the means adopted, not to give steadiness to old varieties, but to evoke new ones."

On the other hand, we must remember that particular kinds of both species and many garden plants—such as Pine-apples, Grapes, Bananas, and most other fruits—are nearly invariably increased or reproduced by the vegetative modes of propagation, and rarely by the sexual method, that is, by seed. In the case of Bananas, Pine-apples, Sultana and Corinth Grapes, vegetative propagation has been practised from time immemorial. The result of this is, that the life of each individual is prolonged, together with its peculiarities, but no new life is originated, and there is no variation as compared with that which almost invariably takes place when plants are raised from seeds. Again, many of the travellers who have hitherto collected natural species and varieties for our gardens, have necessarily, in accordance with their object, chosen the most showy, the most marketable plants, rather than such as would help to throw light on the various questions as to the development and perpetuation of plant-life which now perplex us, and which will continue to occupy our attention until the rising representatives of Darwin, Spruce, and Bates shall have accomplished somewhat of the great work of foreign travel and study which yet remains undone.

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